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# The Evolution and Taxonomy of the Sarcophaginae (Diptera, Sarcophagidae)

SELWYN S. ROBACK

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ILLINOIS BIOLOGICAL MONOGRAPHS: *Volume* XXIII, *Nos.* 3-4

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THE EVOLUTION AND TAXONOMY OF THE SARCOPHAGINAE







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of the Sarcophaginae  
(Diptera, Sarcophagidae)

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## I. Introduction

The calyptrate muscoid Diptera comprises one of the largest and most specialized groups of the Diptera or two-winged flies. The author (1951) proposed a classification of the calyptrate muscoids which divided them into three superfamilies: the Oestroidea, the Muscoidea, and the Sarcophagoidea. The Oestroidea includes the ox-warble flies, the heel fly, and a large group of insect parasites, the Larvaevoridae (Tachinidae). The Muscoidea includes the house fly, the latrine fly, the cabbage maggot, and their allies; and the Sarcophagoidea includes the Calliphoridae, or bluebottle-flies, and the Sarcophagidae, or flesh-flies. For further details and reasons for this classification, see Roback (1951).

The subfamily we are concerned with here, the Sarcophaginae, is one of two into which the Sarcophagidae is divided. The other is the Miltoigramminae. The species of this latter subfamily are generally small gray flies which, as far as is known, are parasitic in the nests of wasps and bees. The Sarcophaginae contains about 1,200 species which vary greatly in size and are generally gray in color, though gold pollinose and metallic colored forms are known. Their food habits vary from parasitism in humans to feeding in dung and decaying vegetable material. The male genital segments, especially in the genus *Sarcophaga*, are shiny red or black and protuberant.

Within the Sarcophaginae, the major problem has been the delineation of the genera. In the past various authors, such as Aldrich (1916), Enderlein (1928a), Townsend (1898-1938), Rohdendorf (1937), and Hardy (1943), have proposed classifications of the Sarcophaginae, or large parts of it. They have used a great variety of characters, external and genital, but no two authors have agreed fully on the supergeneric, generic, and subgeneric divisions to be used. Approximately 175 genera have been proposed within the Sarcophaginae by these authors. Their classifications, with the exception of Rohdendorf's (1937), while adding many names to the literature, have done little toward providing a sound basis for the generic classification of the Sarcophaginae.

It is the belief of the author that the best approach to a sound classification of any group is an understanding of its phylogeny. Only when the phylogeny has been determined can the relationships and natural divisions within the group be understood.

This work is an attempt to discover the probable phylogeny and the



genera and generic groupings within the Sarcophaginae, based primarily on aedeagal structure. A necessary corollary has been the determination of the homologies of the various sarcophagine aedeagal parts.

The general external anatomy of the Sarcophaginae shows very few characters that are of value in determining the paths of evolution of these flies, but the aedeagus, with its wealth of diverse structures, has been found to offer good morphological evidence upon which groupings and phylogenetic conclusions can be based.

Of necessity, this work can be of only a preliminary nature. The male aedeagus is only one facet of all the evidence which can shed light on this problem. The female genitalia must be studied, and more data will have to be gathered on the biology and immature stages. These are poorly known at present. Also many more species need to be studied and the parts of their aedeagi homologized with those described in this paper.

It is hoped that this study will contribute to a more sound and stable classification of the Sarcophaginae.

#### ACKNOWLEDGMENT

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#### MATERIALS AND METHODS

In the course of this study 145 species of Sarcophaginae were studied. Included in these 145 species are 70 per cent of the species listed by Aldrich (1916). Most of the material is Nearctic, but the Palearctic and Neotropical regions are represented. A few Australian species are included.

In addition to the species examined, 224 species were well enough illustrated and described to enable the author to place them definitely



in the genera treated here. Another 130 species were not as well illustrated or described, but could be tentatively placed within the genera. A very large residue of species either are described in literature not available to the author or could not even be tentatively placed on the basis of descriptions and figures available. The species seen, definitely and tentatively placed, are listed alphabetically after the generic or subgeneric descriptions.

The genitalia were studied by clearing them slightly in potassium hydroxide, washing in water, and then dissecting them in glycerine under the binocular microscope. In cases of very membranous phalli, uncleared specimens were also used. The drawings were made with the aid of a squared ocular grid.

The fifth sternite was dissected out and mounted in glycerine on a slide. These slides were projected with a small micro-projector and the drawings made directly on the projected image of the sternite.



## II. Morphology and Terminology

Since the time of Pandellé (1896) and Böttcher (1912-13), the genitalia of the sarcophagids have been used as the major criterion for differentiating and grouping the species. As can be seen in Chart 1, most investigators have worked chiefly within the *Sarcophaga* group. The great variety of phallic structures within this and the other groups of the Sarcophaginae have not been homologized. This discussion is an attempt to describe and elucidate the probable lines of evolution and homology of the parts of the aedeagus within the Sarcophaginae.

With regard to the possible function of all the complex structures found in the phallus, little can be said. I have examined the interlocked genitalia of several species and must, for the present, agree with Patton (1939) that there is nothing in the female genitalia to explain or necessitate such a complex phallus in the male.

### ABDOMEN

The abdomen of the Sarcophaginae is divided into two sections, the preabdomen and the postabdomen.

The preabdomen consists of morphological segments one to five. The first and second segments are fused and considered as the first abdominal in most taxonomic papers. The second, third, and fourth abdominal segments in most taxonomic papers are the third, fourth, and fifth morphological segments. In order to avoid confusion the terminology of these taxonomic systems has been retained in the classification section of this work. Each of the segments consists of a ventrally prolonged tergite and a small sternite placed in the membrane between the ventral edges of the tergite. The fifth sternite is often highly modified and closely associated with the postabdominal segments.

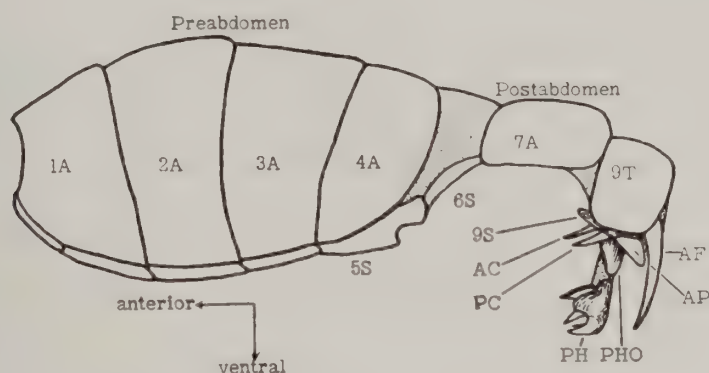
The segments posterior to the morphological fifth, six to nine, constitute the postabdomen. These are highly modified and bear the aedeagus and its associated structures. The sixth sternite is reduced to a latero-ventral band associated with the fifth sternite. The sixth tergite has been lost. The fused seventh and eighth abdominal segments and the ninth segment are generally well sclerotized and form a capsule to protect the aedeagus at rest. They generally fold into the fifth segment forming a cap-like structure at the tip of the abdomen, Fig. 460. They may be large and protuberant as in Fig. 460, or small and hidden by the fifth



morphological tergite. In the Agriini the fused seventh and eighth segments are connected to the fifth by a short membrane, while in the Sarcophagini the membrane is very long, permitting the postabdominal segments to be greatly separated from the preabdomen. The fused seventh and eighth segments will be referred to simply as the seventh abdominal segment. Morphologically they are the sternites of their segments, the tergites having been lost.

The paired anal forceps (AF), Figs. 5 and 334, are placed caudo-ventrally in relation to the ninth tergite. On each side at the ventro-caudal edges of the ninth sternite are the anal plates (AP). The ninth sternite is located between the ventral edges of the ninth tergite. On each side of the ninth sternite, anterior to the anal plates are the anterior and posterior claspers. Projecting ventrally from the center of the ninth sternite, when the postabdomen is extended, is the aedeagus. At rest it is horizontal within the abdomen.

The relationship and orientation of the structures discussed above are shown in Text Fig. 1. The figures on the plates are oriented in a like manner.



TEXT FIGURE 1. Diagrammatic lateral view of sarcophagine abdomen.

#### THE FIFTH STERNITE (5S)

The fifth sternite is the indented, last visible sternite. It usually consists of a basal section and two divergent arms and is either V- or Y-shaped depending on the length of the basal section. The parts of the sternite as used in this work will be the sternal base (B), the sternal arms (A), and the sternal window (W). This last is formed between the bottom tip of the V in the fifth sternite and the cross attachment of the sixth sternite. In the fifth sternite, in which there is no window, the sixth sternite is attached below the lower apex of the V.

The other external features of the Sarcophaginae have been well described and treated in the literature, and there is no need for any extended discussion of them here. While showing some tendencies, they were of little value in working out the phylogeny of the subfamily.



## AEDEAGUS

On the basis of a consideration of all the aedeagal parts found within the Sarcophaginae, the following ancestral aedeagus can be postulated, Fig. 1:

- I. Phallophore—A simple, sclerotized, short tube, dorsally articulating with the ninth sternum and ventrally bearing the phallus.
- II. Phallus—Attached to phallophore by membrane, consisting of the following parts:
  - a) Corpus—tubular basal piece of phallus; longitudinally divided into membranous and sclerous portions.
  - b) Phallic tube—an antero-ventral constriction of the membranous area of the corpus.
  - c) Ventral sclerotization—a transverse, ventrally divided sclerotized band present in the membranocorpus below the phallic tube.

The structures present in the above hypothetical aedeagus have given rise, along different lines, to all the aedeagal structures of extant Sarcophaginae.

Among present-day muscoids, the aedeagi of the Scopeumatinae and in particular those of *Scopeuma stercorarium* (Linn.), Figs. 3 and 4, and *Spathiophora cincta* Loew., Figs. 7 and 8, closely approximate the hypothetical aedeagus.

## PHALLOPHORE (PHO)

This is the tubular, sclerotized basal portion of the aedeagus. As previously mentioned, it articulates dorsally with the ninth sternum; ventrally it bears the phallus. It is present in all Sarcophaginae, generally connected to the phallus by a membrane, but connate with it in *Ravinia*, *Oxysarcodexia* and *Cistudinomyia*, Figs. 246 and 280. A few of its variations are shown in Figs. 25, 58, 309, 316. It never bears any appendages.

## PHALLUS (PH)

This is the apical section of the aedeagus. Basically it consists of a partly sclerotized, partly membranous tube (called the *corpus*), Fig. 1, the phallic tube and the ventral sclerotization. In the more specialized sarcophagids it develops into a very complex structure with many appendages arising from the corpus and internal parts. Instead of discussing it as a whole, which is rather impractical, we shall consider each one of its parts and its development separately. Chart 2 shows the development of the parts in graphic form, and Chart 3 shows the development of the ventral sclerotization.



## CORPUS (C)

As the name implies, this is the body or basal section of the phallus. In its most generalized form, Fig. 1, it could be described as a short tube longitudinally divided into sclerous and membranous portions. These are the sclerocorpus and membranocorpus, respectively. In most cases, the membranocorpus is reduced or non-existent, and the resultant structure will simply be called and labeled the corpus. Only in *Camptops unicolor* Ald. and *Chloronesia* sp., Figs. 36 and 41, is there a well-defined membranocorpus.

Seen in profile, the sclerocorpus extends forward dorsally, while ventrally the membranocorpus constricts to form the phallic tube and then curves inward and downward with the ventral sclerotization.

From this hypothetical corpus, the semi-tubular corpus of the subtribe Servaisiina, such as in Figs. 362, 378, 386, and 393, can easily be derived by the reduction of the membranocorpus and the slight extension and modification of the sclerocorpus.

In some cases, such as *Rafaelia rufiventris* Tns., Figs. 310 and 311, *Euboettcheria australis* Tns., Figs. 305 and 307, and *Sarcodexia lambens* (Wied.), Fig. 302, the dorsal extensions of the sclerocorpus have formed a complete closed ring. This is not the usual case in the Sarcophaginae.

In the Raviniina and *Wohlfahrtia vigil* (Walk.), Figs. 18, 19, and 220-286, the corpus has closed over ventrally and elongated, thus forming the characteristically shaped corpus of both. Parker (1914), on the basis of this development, believed that *Ravinia* and *Wohlfahrtia* were related, but the development is apparently quite independent in each case.

All the variations of form of the corpus can be derived from the hypothetical type, Fig. 1, by variation in the size and shape of the sclerocorpus. They are too numerous to be taken up individually.

In the Sarcophagini, the corpus has given rise to the vesica, juxta, lateral plates, harpes, dorsal rods, and explanate vesica (see Chart 2).

## PHALLIC TUBE (PT)

The phallic tube is an antero-ventral prolongation of the membranocorpus. It is present in all the Agriini seen, being large in *Agria affinis* (Fall.), Figs. 12 and 13, and *Sarcophahrtia ravinia* Park., Figs. 14 and 15, and reduced in *Wohlfahrtia vigil* (Walk.), Figs. 18 and 19. In some of the Sarcophagini it is clearly present though much reduced. This can be seen in *Johnsonia* (*Emblemasoma*) *erro* (Ald.), Fig. 46, and *Johnsonia* (*Johnsonia*) *rufitibia* (Wulp), Figs. 48 and 49. In a few other Sarcophagini, such as *Paraphrissopoda amoena* (Ald.), *P. capitata* (Ald.), *P. hillifera* (Ald.), and *Camptops unicolor* Ald., Figs. 294, 297, 299, and

36, it is apparently represented only by a vestigial sclerotization. *Imparia impar* (Ald.), Figs. 20-22, possesses what is apparently a highly developed phallic tube. It is completely absent in all other Sarcophagini.

#### LATERAL PLATES (LP)

These are plate-like lateral sclerotizations, apparently developed from the membranous section of the corpus. They are clearly present in *Johnsonia* (*Emblemasoma*) *erro* (Ald.), Fig. 46, *Johnsonia* (*Johnsonia*) *rufitibia* (Wulp), Fig. 48, *Johnsonia* sp., Fig. 44, and most of the members of the genus *Helicobia*. *Kellymyia kellyi* (Ald.), Fig. 309, and the members of *Spirobolomyia*, Figs. 350, 352, and 360, all possess semi-sclerous lateral plate-like structures. The affinities of these species are not clear and while the structures will tentatively be considered as homologous with the lateral plates on the basis of their position and structure, more evidence will be needed for confirmation.

#### HARPES (H)

The harpes are paired antero-dorsal extensions of the corpus. They usually arise at the antero-dorsal corners of the sclerous corpus and run ventro-mesad from there. Their points of origin seem to indicate the primitive antero-dorsal corners of the corpus, even when this has been obscured by subsequent sclerotization.

With one exception, the harpes are present only in the *Sarcophaga* group and their presence is one of the characteristics of that group. In their most simple form, they may be only slightly incurved extensions as in *Sarcophaga misera* Walk., Fig. 128. Zumpt and Heinz (1950), Chart 1, called them the vesica. In others, such as *Sarcophaga tarsata* Ald., Fig. 165, each may be a simple ovate sclerotized lobe. *Sarcophaga thatuna* Ald., Fig. 201, *S. occidentalis* Ald., Fig. 186, and *S. carnaria* (Linn.), Fig. 195, present elongate blade-like harpes. Some more complex forms of this structure are shown in *Sarcophaga nigriventris* Meig., Fig. 178.3, where it is bilobed, and in *Sarcophaga pulla* Ald., Fig. 185, where it forms a large antler-like structure. As can be seen in Figs. 75-214, the harpes are a very variable structure with a tremendous number of observed forms.

Though generally solidly attached, the harpes become articulated in the more advanced forms. A secondary suture is formed at their points of origin. This can be seen in *Sarcophaga pulla* Ald., Fig. 185, and *Sarcophaga carnaria* (Linn.), Fig. 199.

*Paraphrissopoda chrysostoma* (Wied.), Fig. 290, and *P. gulo* (Fabr.), Fig. 289, also possess what apparently are harpes. In these species the apparent harpes are slightly different in shape, but their general position and points of origin are correct for that structure. Until further evidence



is discovered, they will be called harpes. *Paraphrissopoda hillifera* (Ald.), Fig. 300, possesses a ventral prolongation of the base of the vesica, which might be confused with the harpes. While it resembles the harpes in shape, close examination shows it to be part of the vesica. It is present only in *P. hillifera* and is not given a name.

#### VESICA (V)

The vesica is the antero-dorsal flap-like appendage of the corpus. It originates as an anterior extension of the membranous area of the corpus and can be seen in its most generalized form in *Camptops unicolor* Ald., Figs. 34 and 36. The vesica in species such as *Sarcophaga pumila* Meig. and *S. arcipes* Pand., Figs. 119 and 124, is also rather generalized. It is from such simple beginnings that the complex sclerotized flap, characteristic of so many of the Sarcophagini, originated. The Agriini seen do not possess a vesica. The developmental process was undoubtedly one of increased flap-like growth followed by sclerotization and then the development of articulation. This process or some variation of it has apparently occurred more than once in the evolution of the Sarcophagini.

The vesica of the genus *Ravinia* is one of the simplest types found. It is a simple depressed flap, slightly expanded distally, Fig. 221. In the genera *Cistudinomyia*, Fig. 286, and *Oxysarcodexia*, Figs. 257-280, it is enlarged and has developed many bizarre variations.

In the *Sarcophaga* group, though very generalized in *Sarcophaga arcipes* Pand., Fig. 124, and a few related species, the vesica has developed into a large and extremely variable structure. As can be seen in Figs. 134, 158, 173, 201, and 206, it is generally bilobed and in a few cases has become split into two parts. This is the case in *Sapromyia cooleyi* (Park.), where it has become two ovate, ventrally spinose lobes, Fig. 97, and in *Sarcophaga haemorrhoidalis* (Fall.), where it has become divided into two separate elongate and divergent lobes, Fig. 210. In *Sarcophaga gracilis* Ald. two similar lobes can be seen with the intermediate sclerotization still present, Fig. 206.

The vesica reaches what is perhaps its peak of bizarre development in *Boettcheria*, in particular *Boettcheria latisterna* Park., Fig. 346. Here it is the dominant element of the phallus.

The plate-like anterior sclerotization of *Rafaelia rufiventris* Tns., Fig. 310, does not have the typical appearance of a vesica but on the basis of its position may represent a very poorly developed vesica. The connate, plume-bearing anterior structure of *Metoposarcophaga*, Figs. 324-335, is also probably a vesica. Its position is correct for a vesica and it can be separated from the specialized corpus.

Most of the members of the *Johnsonia* group and all the Agriini lack a vesica. The vesica in *Johnsonia (Emblemasoma) erro* (Ald.), Fig. 45,

probably represents an independent development, and *Camptops unicolor* Ald. has only a rudimentary vesica, Fig. 36.

#### EXPLANATE VESICA (EV)

This structure is developed in the Servaisiina, particularly in the genera *Servaisia* and *Fletcherimyia*. Like the vesica it has developed from the membranocorpus, but in a different manner. The membrane probably developed first a slight anterior flap-like projection, as in the early stages of the development of the vesica. Unlike the development of the vesica, the membrane below has next expanded laterally and then ventrally. The result is the structure characteristic of many species of the subtribe Servaisiina, Figs. 366-441. There was undoubtedly some variation in the exact sequence and extent of these developments.

The process in *Fletcherimyia* was probably similar but with greater antero-dorsal growth and further sclerotization than that in *Servaisia* and *Acandotheca*. This resulted in the well-developed explanate vesica characteristic of that genus, Figs. 366, 367, 372, 374, and 375.

In some members of the genus *Acandotheca* an antero-ventral projection of the corpus is present. This is the rudimentary explanate vesica. It is attached near its apex to the modified ventral sclerotization (limen), Fig. 427. In *Acandotheca* (*Acandotheca*) *masculina* (Ald.) it is at right angles to the corpus, Fig. 435; and in *Acandotheca* (*Acandotheca*) *prohibita* (Ald.), Fig. 436, it is turned upward in an arc. *Acandotheca* (*Acandotheca*) *eleodis* (Ald.) and *Acandotheca* (*Acandotheca*) *complosa* (Rein.), Figs. 437, 438, and 444, possess a rather well-developed and complex explanate vesica, probably developed as a continuation of this tendency. The close relationship of these four species as shown by their general aedeagal structure lends validity to this hypothesis.

The tendency for the development of the explanate vesica is characteristic of the Servaisiina. It has developed in the subgenera *Acandotheca*, *Lepyria*, and *Stenolaucotheca* of *Acandotheca*; in the subgenus *Protodexia* and the other subgenera of *Servaisia*; and in *Fletcherimyia*.

Other morphological evidence indicates that these three genera arose from a common ancestor which lacked an explanate vesica; and the development of the explanate vesica in each, apparently, was independent.

The homology of the vesica of *Acandotheca* (*Mecynocorpus*) *salva* (Ald.), Fig. 420, is questionable in view of its apparent relationship, but the structure will be called a vesica here until more evidence is available.

#### JUXTA (J)

This is the ventral appendage of the corpus. Its development was probably first as a slight bowing out of the ventral membrane of the corpus, as in *Camptops unicolor* Ald., Fig. 36, followed by apical extension



until it appears to be continuous with the corpus as in *Servaisia* (*Servaisia*) *coloradensis* (Ald.), Fig. 383. This is followed by sclerotization and further modification. It is generally bilobed, Figs. 50, 57, 61, 96, and 403.

In the *Sarcophaga* group there is no sharp distinction between those species in which the juxta is fused and those in which it is freely movable. Rather, there seems to be a gradual transition from one condition to the other, with some species such as *Sarcophaga tarsata* Ald., Fig. 167, and *Sarcophaga sima* Ald., Fig. 61, having a fused juxta; some, such as *Sarcophaga thatuna* Ald., Fig. 201, *Sarcophaga occidentalis* Ald., Fig. 186, and *Sarcophaga carnaria* (Linn.), Figs. 195 and 196, having a partially free juxta; and others, such as *Sarcophaga misera* Walk., Fig. 128, and related species, having a free juxta. With one or two exceptions the juxta is freely articulated in those groups, other than the *Sarcophaga* group, in which it is present.

In both the *Sarcophaga* and *Johnsonia* groups the juxta is generally trough- or scoop-shaped, Figs. 36, 45, and 48. There are many specialized variations present, however, as can be seen in Figs. 41, 58, and 69. Dorsally toward its caudal end the juxta of both these groups bears a prow-like median process. Basally the juxta may develop lateral processes as seen in *Sarcophaga misera* Walk. and related species, Figs. 125, 128, 131, 135; in *Helicobia rapax* (Walk.), Figs. 57 and 58; and in *H. stellata* (Wulp), Figs. 61 and 62.

The juxta in the subtribe *Servaisiina* is bilobed with the lobes spatulate in *Servaisia*, Figs. 385, 396, and 398; short and broad in *Fletcherimyia*, Figs. 366, 367; and pointed in *Acandotheca*, Figs. 428 and 435. In the subgenus *Acridophaga* of the genus *Acandotheca* the juxta is completely separated into two parts, Fig. 403. The copi (see p. 17) have developed caudally on the juxta of *Acandotheca* (*Acandotheca*), Figs. 428, 432, 435, and 436.

Among the species of the *Sarcodexiina* examined, *Sarcodexia lambens* (Wied.) bears what is apparently an extremely specialized juxta, Figs. 302 and 304.

The juxta of *Metoposarcophaga* is either fused as in *Metoposarcophaga* (*Zygastropyga*) *cantenea* (Roback) and *M. villipes* (Wulp), Figs. 326, 335, or free and small in *Metoposarcophaga* (*Zygastropyga*) *aurea* (Tns.) and *M. sulculata* (Ald.), Figs. 329 and 317. In both *Rafaelia* and *Boettcheria* it is free, but is much larger and well developed in *Boettcheria*, Figs. 340 and 342. In this group the anterior juxtal process is present.

In *Ravinia effrenata* (Walk.) a scoop-like juxta has formed and the median process has moved ventrad and become attached to it, Figs. 227 and 229. There is no juxta developed elsewhere in the *Raviniina* or in the *Agriini*.

The copi and lateral and anterior juxtal processes have all developed from the juxta (see Chart 2).

#### LATERAL JUXTAL PROCESSES (LJ)

These are a pair of rods extending laterally and forward from the base of the juxta. They are first developed as membranous lobes, Fig. 113, then become sclerotized and undergo some modification as shown in Figs. 117, 120, 124, and 125. In their sclerotized form they are present only in the *Sarcophaga* group. *Helicobia rapax* (Walk.), Figs. 57-59, and *H. stellata* (Wulp), Figs. 61 and 62, have membranous lateral juxtal processes.

The short membranous flaps developed in *Metoposarcophaga* (*Zygastropyga*) *cantenea* (Roback), Fig. 336, and *Boettcheria carata* Roback, Fig. 345, are probably lateral juxtal processes but the homology is by no means certain.

The lateral processes on the juxta of *Sarcophaga incisilobata* Pand., Fig. 180, are undoubtedly not lateral juxtal processes. Their forward origin and close basal proximity do not support their homology with the lateral juxtal processes of the *Sarcophaga* group. They are specialized structures present only in this species and are not given a name.

#### ANTERIOR JUXTAL PROCESS (AJ)

This is a generally well-sclerotized semi-tubular process developed dorsally at the antero-median edge of the juxta. It is present only in species of the subtribe Boettcheriina, Figs. 335, 340, 342, and 345, and is apparently associated with the well-developed elongate median process of that group.

#### VENTRAL SCLEROTIZATION (VS)

This is the third of the three sclerotized areas present in the hypothetical sarcophagine phallus. It consists of a pair of transverse sclerites developed in the membrane of the corpus. Its lateral ends are usually attached to the ventral corners of the sclerous part of the corpus from which point each arm runs medially and then anteriorly, both arms meeting at the mid-line. The ventral sclerotization in *Spathiophora cincta* Loew fits this description exactly, Figs. 7 and 8 (also Chart 3, hypothetical 1) which illustrates the ancestral condition of this part.

The ventral sclerotization undergoes a different development in each of the major lines of the Sarcophaginae. Chart 2 shows the structures (stemmatis, median process, lateral arms, limen, cunabula, lateral and median dorsal projections, median filaments) which have developed from it, while Chart 3 shows the mode of development in each line.



## MEDIAN PROCESS (MP)

In two of the lines of development of the ventral sclerotization, a split takes place near the median end of each of its arms, Chart 3 (hypothetical 2 and *M. sulculata*).

In Series 2, this split takes place before the ventral sclerotization has undergone any modification. This results in a two-piece median section and two long lateral arms, Chart 3 (hypothetical 2). The two-piece median section fuses to form the median process, Fig. 26. It is never found in its primitive form.

In the Boettcheriina, the median ends of the ventral sclerotization have become joined and prolonged into a median process and the lateral arms have developed into the lateral filaments, Chart 3 and Fig. 311, before the above mentioned split takes place. The split then results in the free and well-formed median process and lateral filaments of the Boettcheriina, Figs. 319, 340, and 343.

The median process of the Sarcophagulina, Raviniina, Hystricocnema, and Boettcheriina remains a relatively free, generally semi-tubular structure, Figs. 238, 239, 260, and 266, while in the Sarcophagina it forms a prow-like structure, Figs. 64, 69, 133, and 136, attached dorsally to the juxta.

In the genus *Ravinia* it is associated with the dorsal rods. It lies ventro-caudal in the corpus of the more generalized species of that genus, Fig. 219, but moves upward with the lower end of the dorsal rods, Figs. 231 and 233, becoming a little more trough-shaped in the process. It retains a membranous connection with the apex of the corpus, Fig. 233. In *Oxysarcodexia*, Figs. 259 and 260, it also moves upward but becomes more elongate and is associated with both the dorsal rods and the lateral arms. In *Cistudinomyia*, Figs. 285 and 286, only the lateral arms are present with it and it has remained short after its upward movement.

As previously mentioned, the development in the Boettcheriina is slightly different from that in Raviniina. In Boettcheriina the split does not take place until after the median process and lateral filaments are well formed. The median process, here, is generally associated with the apical juxtal process which apparently forms a ventral point of support for it, Figs. 342 and 349. The well-developed triad of tubular median process and well-developed filaments is characteristic of the subtribe Boettcheriina.

In the *Sarcophaga* and *Johnsonia* groups the median process has become attached dorsally to the caudal end of the juxta, Fig. 207. Only in *Arachnidomyia* is it forward. *Ravinia effrenata* (Walk.), though not related to these groups, may illustrate the method of this fusion. In *Ravinia effrenata* the short, tubular median process is attached along its

ventral edge to the dorso-caudal end of a relatively generalized juxta, Figs. 227 and 229. From this the next step would be for the median process to lean farther backward and become completely attached along its lateral and dorsal margins. This would result in the typical median process of the *Sarcophaga* and *Johnsonia* groups, Figs. 46, 49, and 146.

The attached median process gives rise dorsally to the sclerous or membranous capitis in the *Sarcophaga* group, Chart 2 and Figs. 121 and 168.

#### CAPITIS (CA)

This is the cap or helmet-like structure developed dorsally on the median process of the *Sarcophaga* group and *Helicobia*. It is either sclerous, Fig. 163, or membranous, Fig. 133, the development of each apparently being independent. More evidence is needed to clarify this point. In its most generalized form the capitis appears dome-like in profile, Fig. 64, but tends to become elongate anteriorly, Fig. 155; and in the genus *Wohlfahrtiopsis* it has become partially detached at its base, Fig. 87. The same development has apparently taken place in *Helicobia* as illustrated by *Helicobia morionella* (Ald.), Fig. 54, and *Helicobia rapax* (Walk.), Fig. 59. The median piece in the genus *Spirobolomyia*, Fig. 355, may be a detached capitis but the homology is doubtful.

#### LATERAL ARMS (LA)

The lateral arms are the outer parts of the ventral sclerotization separated by the median process, Chart 3, hypothetical 2. Only *Cistudinomyia cistudinis* (Ald.), Fig. 285, and *Sarcophagula femoralis* (Schin.), Fig. 26, show this in relatively unmodified form. The apparent lateral arms in *Wohlfahrtia vigil* (Walk.), Fig. 18, may represent the entire ventral sclerotization since there is no indication of the presence of a median process.

In the subtribes Sarcophagina and Boettcheriina and the genus *Oxysarcodexia* they give rise to the lateral filaments, Chart 3 (hypothetical 3, 6, and *O. ventricosa*). They also develop rather complex variations in *Oxysarcodexia*, Fig. 260.

In *Ravinia* they give rise to the dorsally projecting hillae, Chart 3 (*R. stimulans*), and Fig. 226, and then apparently become membranous as there is no indication of their presence after the median process has moved upward, see Charts 2 and 3 (hypotheticals 2, 3, 5, and *R. stimulans*).

#### LATERAL FILAMENTS (LF)

These are a pair of narrow tubular structures lying one on each side of the median process. They are developed from the lateral arms of the ventral sclerotization as is shown in *Rafaelia rufiventris* Tns., Fig. 311,



and on Chart 3 (hypothetical 3, *O. ventricosa*, and hypothetical 6). In *Camptops unicolor* Ald., Fig. 33, the developed and separate filaments are clearly attached to the ventral tips of the corpus.

The filaments of the *Sarcophaga* group generally consist of an elongate semi-tubular rod and a heavy circular base, Figs. 130 and 137. The bases are usually situated laterally within the corpus, with the rods projecting antero-ventrally, Figs. 173 and 178. In some cases the entire filament may be semi-tubular, Fig. 197, while in others it is expanded distally, Fig. 68.

Both the genera *Rafaelia* and *Metoposarcophaga* have rather short filaments with only a slightly enlarged base, Figs. 311 and 319, but in *Boettcheria* and *Helicobia* the filaments become rather elongate and thread-like with a large base, Figs. 346 and 56.

In *Oxysarcodexia* the modified lateral arms give rise to a pair of anteriorly projecting rods which lie on either side of the median process, Figs. 260 and 270. They are free only in *Oxysarcodexia galeata* (Ald.), Figs. 258 and 259. These are probably homologous with the lateral filaments of other Sarcophagini.

#### DORSAL RODS (DR)

These dorsally projecting rods, Chart 3 (*R. stimulans* and *R. l'herminieri*) and Figs. 216 and 223, are developed in the membrane of the corpus on either side of the median process in the genera *Ravinia* and *Oxysarcodexia*. At their dorsal ends, they are attached to the base of the vesica, Fig. 250, and these points of attachment act as the fulcrum for the upward movement of the median process.

The structures in *Boettcheria* which resemble dorsal rods, Figs. 240 and 342, are not attached to the base of the vesica and their homology and nature are not known.

#### HILLAE (HI)

These are well-sclerotized dorsal projections of the lateral arms and are present only in the genus *Ravinia*. In *Ravinia stimulans* (Walk.), *R. latisetosa* Park., and *R. laakei* (Hall), Figs. 217, 220, 226, they are broadly attached, but as the median process has moved up they have drawn away from the lateral arms, Chart 3 (*R. stimulans* and *R. l'herminieri*) and Figs. 231 and 233, though retaining a connection to them. This connecting strap also moved upward, Fig. 233. The hillae in the more specialized species of *Ravinia* have become a pair of movable sausage-like lobes, Fig. 233.

The lateral dorsal projections of *Fletcherimyia*, Fig. 370, and *Agria affinis* (Fall.), Fig. 13, are probably homologous with the hillae.

The median filaments, the limen, the cunabula and the stemmatis are all developed directly from the ventral sclerotization without any sub-

division of that structure. Though given different names because of their great difference in shape, they are homologous structures. Chart 3 (servasiine and sarcodexiine lines) shows the development of these parts.

#### LIMEN (L)

This structure is characteristic of the genus *Acandotheca*. It was apparently developed as is shown in Chart 3 (hypothetical 8, 9, and *A. alcedo*), by an anterior prolongation and expansion of the lateral ends of the ventral sclerotization and the antero-ventral prolongation of the median tips. Its generalized structure is most clearly shown in *Acandotheca* (*Acandotheca*) *alcedo* (Ald.), Figs. 425 and 427. In many species it has developed spines, Fig. 435, or hairs, Fig. 432, laterally or has become specialized in other ways, Figs. 437 and 441, but the fundamental structure can be detected in all cases.

#### CUNABULA (CU)

As in the case of the limen, this structure was derived from the unmodified ventral sclerotization, Chart 3 (*S. coloradensis*, hypothetical 7, *S. opifera*, and *S. aculeata*). It is characteristic of the genus *Servaisia*. The first step in its development was probably the swinging forward and laterad of the median edges of the ventral sclerotization, very much like the opening of a pair of barn doors. The subgenus *Servaisia* illustrates this stage. The next step was the turning inward of the lower point of the median edge until the two lower points met on the mid-line as in *Servaisia* (*Protodexia*) *hunteri* (Hough), Fig. 382. This "rolling under" process continued until the ventral edges of both halves of the ventral sclerotization met on the mid-line. The cradle-like structures found in *Servaisia* (*Acridophaga*) *aculeata* (Ald.), *S. reversa* (Ald.), *S. caridei* (Brèthes), and *S. angustifrons* (Ald.), Figs. 398, 399, 406, and 402, illustrate the completed process.

#### MEDIAN FILAMENTS (MF)

These filaments, characteristic of the Sarcodexiina, greatly resemble the lateral filaments, but the evidence indicates that their origin was different. The median filaments are formed by the antero-ventral prolongation of the median edges of the ventral sclerotization, Chart 3 (hypothetical 4, *P. amoena* and *E. australis*). In *Paraphrissopoda capitata* (Ald.), *P. amoena* (Ald.), and *P. hillifera* (Ald.) the lateral regions of the ventral sclerotization can still be seen, Figs. 293, 298, and 300, and the median filaments are rather short. However, in *Paraphrissopoda gulo* (Fabr.), *P. chrysostoma* (Wied.) and in *Euboettcheria australis* Tns., where the median filaments are long, these lateral regions are not clearly present.



## STEMMATIS (ST)

This wreath-like structure is characteristic of the genus *Fletcherimyia*. It was developed by the formation of lateral dorsal projections on the ventral sclerotization, Chart 3 (*F. jonesi*). The lateral dorsal projections become expanded in *Fletcherimyia jonesi* (Ald.) and *Fletcherimyia celarata* (Ald.) forming a hood-like cap over the median dorsal projections, Figs. 370 and 376. The original ventral sclerotization is no longer clearly recognizable.

## LATERAL AND MEDIAN DORSAL PROJECTIONS (LDP AND MDP)

These are dorsal projections of the ventral sclerotization. The median dorsal projections are apparently developed only in the genus *Fletcherimyia*, Figs. 370 and 376. Lateral dorsal projections are also developed in *Agria affinis* (Fall.), Figs. 11-13, and the hillae of *Ravinia*, Fig. 226, although arising from the separated lateral arms, are probably homologous with the lateral dorsal projections of *Fletcherimyia* and *Agria affinis* (Fall.).

## COP1 (CO)

The copi are paired, sword-like caudal projections of the juxta in the genus *Acandotheca*. They are generally elongate and movable, being set in the membrane of the juxta, Figs. 428, 432, and 434. The similar structures in *Metoposarcophaga* (*Metoposarcophaga*) *importuna* (Walk.) are sclerous and fused to the juxta, and slightly different in position, and are not considered homologous with the copi.

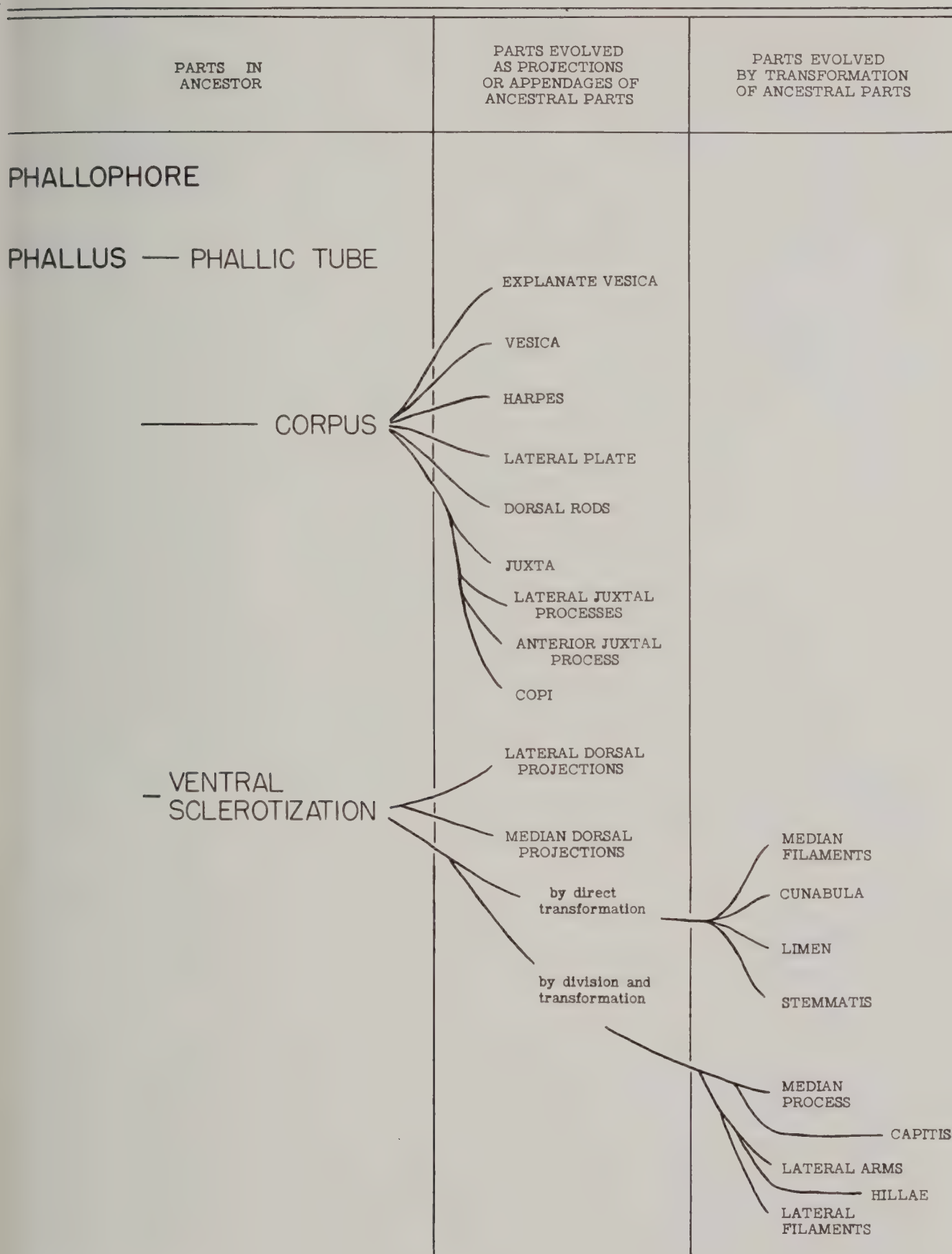
CHART I  
COMPARATIVE CHART OF THE TERMINOLOGY USED BY VARIOUS AUTHORS  
FOR  
THE GENITALIA OF SARCOPHAGINAE

AUTHOR	ZUMPT & HEINZ 1950	CRAMPTON 1942	SÉGUY 1941	SENIOR-WHITE 1940	HALLOCK 1940	ROHDENDORF 1928 & 1937	JOHNSTON & HARDY 1923 & HARDY 1943
Anterior & Posterior Claspers	Anterior & Posterior Parameres	Anterior & Posterior Gonapophysis	Gonapophyse Antérieure et Postérieure	Anterior & Posterior Claspers	Anterior & Posterior Claspers	Vordere u hintere Parameren	
Ninth Sternum	Tergosternum	9 Sternum		Paraphallus	Ninth Sternum	Ninth Seg.	
Anal Plates	Paralobi	Surstyli	Forceps Externe	Paralobes	Anal Plate	Forceps In- feriores— Coxite	
Anal Forceps	Cerci	Cerci	Forceps Interne	Superior Claspers	Anal Forceps	Forceps Superiores— Cerci	
Phallopore	Theca	Phallopore	Théca	Hypophallus		Théka	
Corpus	Harpesbasis			Juxta		Pars Basalis— Paraphallus	Sheath
Harpes	Harpes		Paraphallus ?	Appendage of Juxta		Styli	Lobe
Vesica	Vesica— Membrana- nallobi		Hypophallus	Vesica		Ventrallobi— Membrana- nallobi	Anterior Appendage
Explanate Vesica						Lobi Ventrals	
Juxta	Juxta		Prépuce	Harpe		Pars Distallis— Apikallobi	Apical Process
Lateral Juxtal Processes	Process of Juxta		Piece Terminal du Penis				Lateral Process
Lateral Filaments	Harpes—Proc- ess of Juxta		Stylet du Paraphallus	Median Appendages			Filament
Limen						Pars Interior	
Capitis							Inner Process



CHART 2

EVOLUTION OF SARCOPHAGINE AEDEAGAL STRUCTURES



### III. Phylogeny

Roback (1951) postulated the origin of the Sarcophagidae and Calliphoridae from the most primitive of the families of the muscoid calyptrate Diptera, the Anthomyiidae. This was on the basis of evidence drawn from both the larvae and adults. The Anthomyiidae, consisting of two subfamilies, the Anthomyiinae and the Scopeumatinae, were placed in the superfamily Muscoidea in the classification proposed. Both these subfamilies are mostly saprophagous and coprophagous in nutrition.

In the present work the careful examination of the aedeagi of one of the subfamilies of the Sarcophagidae, the Sarcophaginae, indicates that the Sarcophaginae probably arose from the ancestors of the more primitive of the two subfamilies of the Anthomyiidae, the Scopeumatinae. The members of this subfamily are mostly dung feeders and possess a very generalized chaetotaxy. The aedeagi of some extant Scopeumatinae, such as *Scopeuma stercorarium* (Linn.), Figs. 2-5, and *Sapthiophora cincta* Loew, Figs. 6-8, are very close in form to some of the more primitive Sarcophaginae, such as *Camptops unicolor* Ald., Figs. 34-36.

The other subfamily of the Sarcophagidae, the Miltogramminae, is not considered here, but the aedeagi examined, as in Fig. 9, and seen in the literature, Allen (1926), Patton (1939), indicate that it could have arisen from the same ancestor as the Sarcophaginae.

On the basis of a consideration of the morphology of extant Sarcophaginae and Scopeumatinae, the following characters are postulated for the archetype of the Sarcophaginae:

#### *Head, Thorax, and Abdomen*

1. Arista bare.
2. Proclinate fronto-orbitals present on head in male.
3. Frontal rows, of head bristles, parallel.
4. Two notopleurals.
5. Two posterior dorsocentrals.
6. Three or four hypopleurals.
7. Scutellum with only laterals.
8. Abdomen without macrochaetae.
9. Membrane between fifth and seventh abdominal segments short.
10. Hind tibiae bare.
11. First and fifth veins bare.



*Genitalia*

1. Phallic structure simple, Fig. 1.
2. Ventral sclerotization and phallic tube present.
3. Phallopore and phallus articulated.
4. Fifth sternite simple, Fig. 10.
5. Sixth sternite not attached to fifth.
6. Anal plates large, clasper-like, Fig. 5.

*Nutrition*

1. Coprophagous or saprophagous.

## MORPHOGENETIC EVOLUTION

From the above ancestor, two major lines, the tribes Agriini and Sarcophagini have arisen, Chart 3. In the former, the fifth sternite has remained simple, Fig. 6; the membrane between the morphological fifth and seventh abdominal segments has remained short; the frontal rows are parallel or gradually divergent; and the sixth sternite has remained free of the fifth. In the Sarcophagini, the fifth sternite is V- or Y-shaped, Figs. 35, 60; the membrane between the morphological fifth and seventh abdominal segments has become elongated; the frontal row is generally slightly divergent in the lowest bristles; and the sixth sternite has become attached to the fifth.

On the basis of its retention of so many of the features of the archetype, the Agriini can be considered the more primitive of the tribes.

## AGRIINI

The subtribes Wohlfahrtiina, Sarcophahrtiina, and Agriina constitute the tribe Agriini, Chart 3. Each is monogeneric.

In *Wohlfahrtia* and *Sarcophahrtia* the phallus has partially or entirely closed over, Figs. 15, 18, and 19, and the ventral sclerotization has not developed any projections; but in *Agria* the phallus is completely open ventrally, and the ventral sclerotization has developed large lateral dorsal projections, Figs. 11-13. Each of the genera exhibits its own specializations, and without the examination of more specimens it is difficult to determine definitely the most generalized and specialized members of this tribe.

*Agria* on the basis of the open corpus could be considered the most generalized, while *Wohlfahrtia*, on the basis of the well-formed ventral closure and its habit of human myiasis, is probably the most specialized. *Wohlfahrtia* is the most widely distributed of all three genera, being found in all regions but the Neotropical and Australian (see Chart 3).

Superficially the aedeagus of *Wohlfahrtia vigil* (Walk.), Fig. 19, resembles that of many members of the genus *Ravinia*, Fig. 243. Parker

(1914b) thought that this indicated relationship between the two. However, a close examination of aedeagal structure shows that this is a case of convergence of form between two widely separated genera.

#### SARCOPHAGINI

The tribe Sarcophagini is, both in number of species and individuals, the larger of the two subtribes of the Sarcophaginae, and the phylogeny of its components constitutes the major part of this discussion. The phylogeny of the three series within it, and the subtribal and generic components of each series will be explained. This phylogeny is shown graphically on Charts 3-9.

The archetype for the Sarcophagini differs from that for the Sarcophaginae in the following characters:

1. Arista plumose.
2. Frontal rows, of head bristles, generally slightly divergent below.
3. Membrane between the morphological fifth and seventh abdominal segments long, Text Fig. 1.
4. Fifth sternite V- or Y-shaped.
5. Sixth sternite attached to fifth.

Within the Sarcophagini there are three major lines of development, Series 1, 2, and 3.

Series 1 consists of the monogeneric subtribe *Impariina*. The genus in turn consists of only the very aberrant species *Imparia impar* (Ald.). The asymmetrical phallus and the large flaring phallic tube, Figs. 20-22, are unique within the Sarcophagini. On the basis of the large phallic tube it is considered the most primitive of the subtribes.

Series 2 consists of the subtribes Sarcophagulina, Hypopeltina, Hystriocnemina, Chart 3; Sarcophagina, Charts 4 and 5; and Raviniina, Chart 6. In all of these the ventral sclerotization has formed a median process and lateral filaments, Fig. 26, which have generally undergone subsequent modification. On the basis of the large number of species with coprophagous and saprophagous nutrition and the more primitive chaetotaxy of some of its species, Series 2 is considered more generalized than Series 3.

Series 3 consists of the subtribes Sarcodexiina, Chart 7; Boettcheriina, Chart 8; and Servaisiina, Chart 9. The ventral sclerotization has undergone direct modification or has split into three parts after modification, Chart 3, Boettcheriina line.

The generally parasitic or predaceous habits of the member; of this Series, the fact that there are never less than three posterior dorsocentrals, and the absence of proclinate fronto-orbitals in the males place this as the most specialized of the three Series.



As far as can be determined from the morphological evidence, all three originated from a common ancestor. The relationships and phylogeny of the subtribes will be discussed under the Series headings and the generic relationships and phylogeny under the subtribal headings.

### Series 2

In the subtribe Sarcophagulina, Chart 3, the lateral arms are barely modified, Fig. 26, and have not moved, Fig. 27. There is no juxta present and the fifth sternite is small and weakly indented, Figs. 24 and 28. Proclinate fronto-orbitals have been retained in the male and there are only two notopleurals. The vesica is large and rather specialized, Figs. 25, 29. All this supports the primitive position accorded this subtribe. It is undoubtedly the most generalized of the subtribes of Series 2.

The two species (*S. femoralis* (Schin.) and *S. occidua* (Fabr.)) included in the Sarcophagulina have generally been placed in separate genera, *Sarothromyia* and *Sarcophagula*, respectively. However, the similarity of phallic structure and overall external characters between the two species do not support this distinction, and they are both included in the genus *Sarcophagula*.

### SARCOPHAGINA

In the subtribe Sarcophagina, the ventral sclerotization has developed into the median process and lateral filaments, Chart 3. The median process has fused to the juxta, Fig. 102, which is present in all genera of this subtribe except *Argoravinia*.

Although the Sarcophagina contains some very primitive genera and species, it is probably one of the most specialized of the subtribes of Series 2. Many of its species are parasitic and have even become human parasites. The phalli of many species are very specialized.

Within this subtribe two large generic groups are recognized. The members of the more generalized of the two, the *Johnsonia* group, Chart 4, generally lack a well-developed vesica and have generally retained a vestige of the phallic tube, Figs. 41, 44, 49. They may have as few as two posterior dorsocentrals and two notopleurals. The membrano-carpus is often well developed, Figs. 36, 41. The genera *Camptops*, *Chloronesia*, *Argoravinia*, *Johnsonia*, and *Helicobia* are included here.

On the other hand, the genera of the *Sarcophaga* group, Chart 5, always have at least a small vesica, never have a phallic tube, and do not have less than three posterior dorsocentrals and four (sometimes apparently three) notopleurals. The corpus here is generally well developed and sclerotized, Fig. 167. The genera *Sarcomyia*, *Sapromyia*, *Arachnidomyia*, *Wohlfahrtiopsis*, and *Sarcophaga* are placed here.

## JOHNSONIA GROUP

The genus *Camptops*, though possessing a vesica, Fig. 36, must have evolved rather early. The presence of only two notopleurals, proclinate fronto-orbitals on the male of *C. unicolor* Ald., the highly membranous phallus, Fig. 36, and the small, weakly indented fifth sternite, all support such a conclusion.

The genus *Harpagopyga* has been separated from *Camptops* on external chaetotaxy, but the phalli of the two are very close morphologically, and the two genera are here combined as the genus *Camptops*.

The genus *Chloronesia* here includes the genus *Notochaeta*. These two have been combined, as were *Camptops* and *Harpagopyga*, on the basis of the morphological similarity of the male phallus.

Though some of its species may have as few as two posterior dorso-centrals and two notopleurals, *Chloronesia* is accorded a higher position than *Camptops*, Chart 4, on the basis of the larger and better developed sclerocorpus, Fig. 41, and the well-developed fifth sternite, Fig. 42. Also, proclinate fronto-orbitals are not present in the male.

The placement of the genus *Argoravinia* is a tentative one. Its phallic structures, Figs. 38, 39, do not show any clear relationship to any other Sarcophagini seen, and it is placed here on the basis of the shape of the sclerocorpus and the relatively large membranocorpus. Its phallus bears some resemblance to that of *Chloronesia*.

The genus *Johnsonia*, as used here, is a combination of the genera, *Johnsonia*, *Emblemasoma*, and *Sthenopyga*. The genitalia of all three, Figs. 44, 45, 48, are too close structurally to admit of generic separation. The well-developed vesica of *Emblemasoma*, Fig. 45, merits subgeneric recognition for it.

The juxta in *Johnsonia* is well developed and sclerotized in contrast to the lightly sclerotized juxtae in *Camptops* and *Chloronesia*, Figs. 36, 41. The lateral plates, Figs. 44, 45, 48, have developed in the membranocorpus and there is very little membranous area left in the phallus. There are three or four posterior dorsocentrals. The phallus of *Johnsonia* is more advanced than that of *Camptops*, *Chloronesia*, and *Argoravinia*.

The subgenus *Johnsonia* provides the probable point of origin for the genus *Helicobia*, Chart 4. The depressed juxta, Figs. 44, 62, the lateral plates, Figs. 48, 58, the lack of a vesica, the barely divergent frontal row, and three posterior dorsocentrals are common characters to both. The juxtae of *Johnsonia* (*Johnsonia*) *rufitibia* (Wulp), Fig. 50, and *Helicobia rapax* (Walk.) are very similar in ventral view.

*Helicobia* has developed a ribbon-like lateral filament, Fig. 56, and has lost the phallic tube completely. The capitis is developed here and has become almost completely detached in *Helicobia rapax* (Walk.), Fig. 59. *Helicobia australis* J. and T., although not a typical *Helicobia*,



is tentatively placed here until its affinities can be more definitely established, Figs. 63-66. *Helicobia* is the most specialized genus of the *Johnsonia* group.

#### SARCOPHAGA GROUP

The *Sarcophaga* group probably arose early from the *Johnsonia* group stock, Chart 4. Its closest affinities in the *Johnsonia* group are to the genus *Camptops*. The form of the lateral filaments and corpus is similar in both. The *Sarcophaga* group could not have been derived from any of the genera above *Camptops*. The fifth sternite of all these genera has a well-developed window, Figs. 42, 43, 47, 51, 60, while the most generalized members of the *Sarcophaga* group lack the window, Figs. 103, 107, and could not have arisen from these genera.

The genus *Sarcomyia*, though possessing a rather specialized phallus, Figs. 79, 80, must have been an early offshoot of the *Sarcophaga* line, Chart 5. The bare hind tibiae, relatively simple fifth sternite with few hairs and no window, the poorly developed median process and lack of a capitis, all indicate an early origin for this genus. The phallus of the only species placed in it, *S. scelestus* (Hall), shows no clear relationship to that of any other Sarcophagini seen.

*Arachnidomyia*, Chart 5 and Figs. 67-78, though it also lacks the hair on the hind tibiae, is more advanced than *Sarcomyia* on the basis of the well-developed median process and capitis, Fig. 69. Also, the fifth sternite possesses a window. *A. aldrichi* (Parker), though possessing thin lateral filaments, Fig. 78, and a more depressed juxta than the other members of this genus, Figs. 76, 77, is included here on the basis of the position and shape of the median process, Fig. 77, the resemblance of its harpes to those of *A. houghi* (Ald.), Figs. 76, 75, and the bare hind tibiae.

The placement of the genera *Sapromyia* and *Wohlfahrtiopsis* is a difficult problem. The shape of the fifth sternite, its elongate base, widely spread arms, and heavy bristles at the base of the V, Figs. 83, 85, 88, 91, 95, and 101, relate the two genera to each other, as does the small, freely articulated juxta of both.

The phallic structures of both are so specialized as to give little evidence as to their relationships to other genera and to their probable point of origin, Figs. 82-102. On the basis of the bare hind tibiae of *Wohlfahrtiopsis*, we can say that it probably arose at a point close to that of *Arachnidomyia*, Chart 5. The genus *Sarcophaga* probably also arose with these two.

The bare hind tibiae of *Wohlfahrtiopsis*, as well as the smaller number of bristles on the fifth sternite, Figs. 83, 85, 88, indicate that it was the first of the two genera to differentiate, Chart 5. Both genera have undergone very rapid evolution and have left no intermediates.

*Sarcophaga* is the largest and most widely distributed of the genera

of Sarcophagini. Most of its members have the hind tibiae villous and generally have well-developed harpes, median process and capitis, Figs. 103-214. The fifth sternite of the most generalized members of this genus lacks a window, Figs. 103, 107, but possesses a strong brush of bristles. Most of the species have a window in the fifth sternite. The genus probably had a common origin with *Arachnidomyia* and *Wohlfahrtiopsis*, Chart 5. There is no evidence to indicate a later or completely separate origin.

No attempt has been made to divide this genus further into other genera or subgenera. The probable evolution of the species treated here is shown on Chart 5. There is no single point or points where the author felt that good generic or subgeneric divisions could be drawn. The pattern of phallic structure in *Sarcophaga* is basically of the same mold in all, and it is felt that the relationship of the species seen is best expressed by including them in a single genus.

#### RAVINIINA

The subtribe Raviniina consists of the genera *Ravinia*, *Oxysarcodexia*, and *Cistudinomyia*, Chart 6. The ventral sclerotization shows a tendency to move upward into the corpus after its division, Fig. 243. This is the condition present in all but a few species of the genus *Ravinia*, Figs. 219, 232. A juxta is not present (except in the aberrant *R. effrenata* (Walk.), Figs. 227, 229) and lateral filaments are present only in the genus *Oxysarcodexia*, Figs. 266, 270.

The fifth sternites of all three genera are similar, Figs. 234, 272, 287; and the phallophore and phallus of all three are fused, Figs. 233, 280.

The lack of a juxta indicates that Raviniina must have separated from the sarcophagine line before the development of the juxta in that line, Charts 5, 6. It has developed some very specialized phallic structures, but its food habits are mostly saprophagous and coprophagous. There are few parasites recorded in this subtribe.

*Cistudinomyia* is probably the earliest offshoot of this line, Chart 6. Although the vesica is very specialized, the relatively unmodified lateral arms and lack of dorsal rods, Fig. 285, indicate that it must have differentiated before either *Ravinia* or *Oxysarcodexia*, both of which possess dorsal rods, Figs. 216, 270. After its separation, the median process and lateral arms moved upward. Its rather specialized habit of parasitism in turtles points to an early origin and subsequent specialization.

The ventral closure, prolongation of the phallus, and the movement upward of the ventral sclerotization seem to be common tendencies in this subtribe. They have occurred in all three genera.

The development of the dorsal rods in the main stock gave rise to the



progenitor of the genus *Oxysarcodexia*. In this genus the phallus is partially closed over ventrally, Figs. 273, 274, and the median process and lateral arms have moved upward, Fig. 269, but not as much as in the genus *Ravinia*, Fig. 252. The lateral arms have developed complex modifications and have given rise to the thin lateral filaments, Fig. 260.

In *Oxysarcodexia galeata* (Ald.), the lateral filaments are present, but the remainder of the lateral arms have apparently been lost, Figs. 258, 259. The projections present on the inner side of the sternal arms, Fig. 256, grow longer in this genus, increasing the depth of the V and pushing the peaks of the lateral arms laterad, Figs. 263, 265, 271. The vesica develops many bizarre variations, Figs. 261, 262, 264, 274.

The development of the hillae from the lateral arms, after the formation of the dorsal rods, would give the prototype for *Ravinia*. *R. stimulans* (Walk.) is not far from this hypothetical type, Figs. 217, 219. In fact, without the hillae and dorsal rods, it would not be far removed from the ancestor for the entire Raviniina.

In *Ravinia*, as in *Cistudinomyia* and *Oxysarcodexia*, the parts of the ventral sclerotization have moved upward and inward. Unlike the latter two genera, the beginning and at least one of the intermediate steps are present here. In *R. stimulans* (Walk.) the hillae are firmly attached, and the median process and lateral arms are ventral in the corpus, Figs. 215-219. In *R. errabunda* (Wulp), Figs. 230-232, the hillae, though still well sclerotized and pigmented, have pulled away from the lateral arms and remain attached to these vanishing pieces by a caudo-ventral band. The median process has moved partially upward into the corpus, and the dorsal rods are no longer vertical. In a species such as *R. pherminieri* (R. D.), which represents the end point of this process, Figs. 242-244, the hillae have become light and sausage-shaped. Their connectives are now almost completely horizontal, as are the dorsal rods. The corpus, Fig. 243, is more elongate and more completely closed over than in either *Cistudinomyia* or *Oxysarcodexia*. The upper ends of the dorsal rods are attached to the base of the vesica, Fig. 250, and these points act as the fulcrum for the upward movement of the median process and the lower ends of the dorsal rods.

The fifth sternite shows progressive change as one goes from *R. stimulans* (Walk.), *R. laakei* (Hall), and *R. latisetosa* Park., Figs. 218, 224, 225, where the V is wide, to the higher species of *Ravinia*, where the V has become narrower and deeper, Figs. 234, 235, 239, 242.

The current division of this genus into *Ravinia* and *Chaetoravinia* on the basis of the setulose first vein cannot be accepted when the genitalia are carefully considered. The fact that intermediates, such as *R. errabunda* (Wulp) and *R. dampfi* (Lopes), are present would lend doubt

to the validity of this generic division. The genitalia of these two species are closer to those of *Ravinia*, in the strict sense, but they possess the setulose first vein of *Chaetoravinia*. Since the genitalia show phylogenetic direction while the setulose first vein crops up again and again, it seems better to consider *Chaetoravinia* and *Ravinia*, in the strict sense, as one genus—perhaps in the process of splitting into two genera, but not yet there. Townsend's (1917b) group of splinter genera are not at all tenable.

The remaining two subtribes of Series 2 are the Hypopeltina and the Hystricocnemina, Chart 3. Each consists of a monobasic genus, *Hypopelta* and *Hystricocnema*, respectively. Both are aberrant subtribes and their placement is tentative. Neither genus shows clear relationship to any other known Sarcophagini.

#### HYSTRICOCNEMINA

*H. plinthopyga* (Wulp) possesses a tubular median process, and lateral filaments, Figs. 283, 284, which resemble those of *Sarcophaga fulvipes* Macq., Fig. 192. It does not possess juxta, vesica, harpes, or capitis and probably differentiated very early before those structures evolved. The form of the corpus, Fig. 281, anal plates, and anal forceps, Fig. 453, is very specialized.

#### HYPOPELTINA

*Hypopelta scrofa* Ald. with its sail-like vesica, odd corpus, Figs. 30, 32, and small filaments, Fig. 31, is a difficult species to place. It shows affinities to both Series 2 and the subtribe Boettcheriina of Series 3, Chart 8. It possesses lateral filaments, but the homology of the median process is very doubtful and is of no help in placing the species.

The small size of the filaments, Fig. 31, suggests an early origin from the base of Series 2, Chart 3, rather than from the subtribe Boettcheriina of Series 3. The lateral filaments of the species placed in the latter subtribe are very much larger than those of *Hypopelta*, Figs. 314, 336, 346, and a great deal of reduction would have to be postulated to arrive at those of *Hypopelta*. Since the lateral filaments, when present, show a tendency to enlarge or elongate, it seems more reasonable to assume that the lateral filaments of *Hypopelta* evolved small and remained small, rather than to assume that they were reduced from those of any extant *Boettcheriina*.

To propose their development from the lateral arms of a common ancestor with the Boettcheriina would involve postulating not only reduction, but also that the split in the ventral sclerotization, after its modification, occurred twice, in separate lines.



## Series 3

The three subtribes of Series 3, the Sarcodexiina, Boettcheriina, and Servaisiina, as far as can be seen at present, probably arose from a common ancestor. Each subtribe presents its own specializations and it is difficult to designate any as the most generalized or specialized. Most of the species in all three are parasitic, though a very few saprophagous and predaceous forms are known.

## SARCODEXIINA

The subtribe Sarcodexiina of Series 3, Charts 3 and 7, is characterized by possession of median filaments, Fig. 290. It consists of three genera, *Paraphrissopoda*, *Euboettcheria*, and *Sarcodexia*.

Of these three, *Paraphrissopoda* is undoubtedly the most generalized. Though all of its species possess a vesica, Figs. 289, 290, 294, 297, 299, the more primitive members of the genus, *P. amoena* (Ald.), *P. hillifera* (Ald.), and *P. capitata* (Ald.), Figs. 293, 298, 300, still retain the lateral sections of the lateral arms and possess a rudiment of the phallic tube. *Paraphrissopoda* and the *Euboettcheria*-*Sarcodexia* line arose from a common ancestor.

*Euboettcheria* has developed a specialized elongated corpus, lacks a vesica, and has lost all trace of the lateral sections of the lateral arms, Figs. 305, 307, and phallic tube. It probably differentiated before the development of the vesica.

*Sarcodexia*, whose phallus also lacks a vesica, bears some resemblance to *Euboettcheria* in the long median filaments and tubular base of the corpus, Figs. 302, 204. It probably differentiated from a common ancestor with *Euboettcheria* and subsequently developed the very specialized bifurcate juxta and its other specialized genital structures, Chart 7.

## BOETTCHERIINA

The subtribe Boettcheriina is the only one of Series 3 in which any division of the ventral sclerotization takes place. Unlike Series 2, here it takes place after the median process and lateral filaments have become distinctly formed, Chart 3. Eight genera constitute this subtribe. These are *Rafaelia*, *Metoposarcophaga*, *Aphelomyia*, *Boettcheria*, *Spirobolomyia*, *Kellymyia*, *Cucullomyia*, and *Tylomyia* (see Charts 3 and 8).

The genus *Rafaelia* is the most generalized of this subtribe. It is the only genus in which the lateral filaments and median process are still connected, Figs. 311, 314, though well formed. The structure of the corpus, Figs. 310-313, juxta, and vesica is very simple. *Rafaelia* comes very close to being the ancestor for the subtribe Boettcheriina.

*Metoposarcophaga* is one of the few genera of Sarcophagini which has

retained large anal plates, Figs. 333, 334, and small anal forceps. Its separation must have taken place early, before the reduction of the anal plates in *Rafaelia*. *Boettcheria* also possesses moderately elongate anal plates, Fig. 450, and short anal forceps. Its origin is close to that of *Metoposarcophaga*, Chart 8.

The corpus, vesica, and phallopore of *Metoposarcophaga* are extremely specialized, Figs. 316, 317. The plume-like vesica and capsule-like corpus are unique within the Sarcophagini.

The subgeneric division within *Metoposarcophaga* is based on both external and genital characters. The presence of only three posterior dorsocentrals, bare hind tibiae, and the more rounded corpus, Fig. 324, places the subgenus *Metoposarcophaga* as the more generalized of the two subgenera. Also, its genital segments do not protrude as much as those of *Zygastropyga*, Fig. 460, and the fifth sternite is simpler, Fig. 321. In the latter subgenus there are four posterior dorsocentrals, the hind tibiae are villous, and the corpus projects caudally, Fig. 316 (see Chart 8).

*Boettcheria* is a very specialized genus and, as mentioned before, probably arose with, or close to, *Metoposarcophaga*, Chart 8. There is no evidence upon which to separate them. The vesica, Figs. 337, 341, 344, 348, and the lateral filaments, Fig. 346, have become very large and specialized. The frontal row reaches its greatest divergence below in this genus.

The remaining genera of this subtribe are all rather aberrant and unique forms. They show little clear relationship to each other or to any other Sarcophagini and are placed in this subtribe on the basis of the possession of lateral filaments and a free median process and juxta, or on a resemblance to one of the genera mentioned or to one another (*Kellymyia* and *Spirobolomyia*).

*Aphelomyia* does not possess any of the triad of processes, but its vesica, Fig. 330, bears great resemblance to that of *Metoposarcophaga*, Fig. 327, and it is placed close to that genus.

*Spirobolomyia* possesses a well-developed triad of median process and lateral filaments, Fig. 355, but the structure of the parts is not identical with those of *Boettcheria* and *Metoposarcophaga*. The species of this genus possess semi-sclerous lateral plates, and the form of the corpus and fifth sternite of all of them is unique, Figs. 352-355.

*Kellymyia* is placed close to *Spirobolomyia* on the basis of its possession of semi-sclerous lateral plates. The phallus is unique in all other respects and lacks the triad of processes, Figs. 308-309.

Both *Tylomyia* and *Cucullomyia* possess very unusual phalli which show little relationship to those of any other Sarcophagini, Figs. 357, 362. The possession of the triad of processes places them in this subtribe, but their more exact affinities are not ascertainable at present.



## SERVAISIINA

In the subtribe Servaisiina, the ventral sclerotization has become modified, but no division has taken place. The three genera definitely placed in it, *Fletcherimyia*, *Servaisia*, and *Acandotheca*, each represent a different modification of the ventral sclerotization, Chart 3. The fifth sternite of all three is very similar, Figs. 369, 391, 430; a juxta is generally present; and there is a tendency for the development of the explanate vesica. When present, this latter structure is characteristic of the subtribe. The point of origin of this subtribe is probably close to that of Boettcheriina and Sarcodexiina, Charts 3 and 9.

*Kurtomyia* contains only the single aberrant species, *K. postilla* (Rein.), Fig. 410. It is placed in this subtribe on the basis of the similarity of its fifth sternite, Fig. 408, to those of the genera *Servaisia* and *Acandotheca*.

*Fletcherimyia* is a very distinctive genus of four species, all of which have been reared from the cups of *Sarracenia*. All four species possess the stemmatis, Fig. 370, a large, well-formed explanate vesica, Figs. 366, 367, and a bilobed juxta, Fig. 366. The lobes of the juxta are soft, hairy, short, and apically down-turned, Figs. 366, 367. The stemmatis shows some progressive development within the genus, being larger and better developed in *F. jonesi* (Ald.), Fig. 370, and *F. celarata* (Ald.), Fig. 376, than in *F. fletcheri* (Ald.), Fig. 366.

The development of the cunabula is the distinguishing characteristic of the genus *Servaisia*, Chart 3. A juxta and the explanate vesica are generally present. It consists of the subgenera *Acridophaga*, *Servaisia*, *Sarpedia*, *Protodexia*, and *Speciosia*.

The subgenera *Sarpedia* and *Servaisia* possess the earliest stage in the development of the cunabula, Figs. 385, 368, 389. Here the median tips of the arms of the ventral sclerotization have swung forward, but the "rolling under" process is partially complete, Fig. 382, and in *Acridophaga*, Figs. 402, 403, the process is complete. The sequence of evolution of the subgenera is not linear as above.

The subgenus *Protodexia* lacks any trace of a juxta, Figs. 377, 380, and was probably the first to differentiate, Chart 2. As mentioned above, the cunabula in this subgenus has developed to a point where it probably represents the intermediate condition between the subgenera *Servaisia* and *Acridophaga*.

The subgenus *Sarpedia* possesses a very small juxta, Fig. 389, and could have arisen together with the subgenus *Servaisia*, the juxta in *Servaisia* having undergone subsequent development after the separation of the subgenera, Figs. 392, 396. The structure of the cunabula is similar in both, Figs. 389, 393. One of the species in *Sarpedia*, *S. (Sarpedia) setigera* (Ald.), is the only web-spinning sarcophagid that has been recorded, Branch (1920).

In *Acridophaga* the juxta, basically the same in structure as in *Servaisia*, has completely split at its base, forming two lobes, Figs. 402, 403. This would indicate that it probably developed from *Servaisia* after the juxta was fairly well developed there, Chart 9. The cunabula in *Acridophaga* is fully developed, Figs. 399, 401, 407, and cradle-like. The explanate vesica, present in all members of the subgenus *Servaisia*, Figs. 383-387, 391-396, is also present in all species of *Acridophaga*, but is more pigmented and sclerotized in the latter, Figs. 397-407.

The genitalia of the subgenus *Speciosia* are very aberrant, Figs. 411, 412, 458. The only species, *S. (Speciosia) speciosa* (Lopes), possesses a cunabula similar to that of *Protodexia* and lacks a juxta. It has therefore been placed close to the last mentioned subgenus, Chart 9. Its fifth sternite, Fig. 411, is like that of other members of the genus *Servaisia*.

The genus *Acandotheca* is characterized by the possession of the limen. It has been divided into five subgenera here. These are *Stenolaucotheca*, *Acandotheca*, *Tephromyiella*, *Lepyria*, and *Mecynocorpus*, Chart 9.

The subgenera *Stenolaucotheca*, *Lepyria*, and *Mecynocorpus* all lack a juxta, Figs. 414, 420, 423, while the subgenera *Tephromyiella* and *Acandotheca* possess this structure, Figs. 417, 428. The first three subgenera probably arose before the latter two, but it is impossible to assign any sequence of origin to them, Chart 9. Each presents its own unique specializations.

The juxta in *Tephromyiella* is large and scoop-shaped, Figs. 416, 418, very different from the bifurcate, sharply pointed juxta of *Acandotheca*, Figs. 428, 429. The copi have developed on the juxta of *Acandotheca*, Fig. 435.

All three genera of the Servaisiina probably arose from a common ancestor. There is no evidence to show any sequential arrangement of their origins.

As can be seen in the foregoing discussion, genital characters are of great value in determining the phylogeny and relationships within the Sarcophaginae. The external characters and chaetotaxy were found to be of very little value in this regard. They did, however, demonstrate certain tendencies throughout the Sarcophaginae, and the more important of these are listed below.

1. Toward villous hind tibiae.
2. Setulose veins besides the third (first and fifth).
3. Increased abdominal chaetotaxy.
4. Increased divergence of the frontal row, below.
5. Increase in number of hypopleurals.
6. Increase in number of posterior dorsocentrals.

*Xenoppia hypopygialis* Tns. (equals *Camptopyga aristata* Ald.) was



considered by Aldrich in his "*Sarcophaga* and Allies." The phallus and fifth sternite of this species are very aberrant, Figs. 442-445, and its nearest relatives are apparently in the Amobiini of the subfamily Miltogramminae. *Neophyto setosa* Coq., Figs. 446, 447, is very close to it on the basis of the aedeagus and could be ancestral to *X. hypopygialis*.

### CHART 3

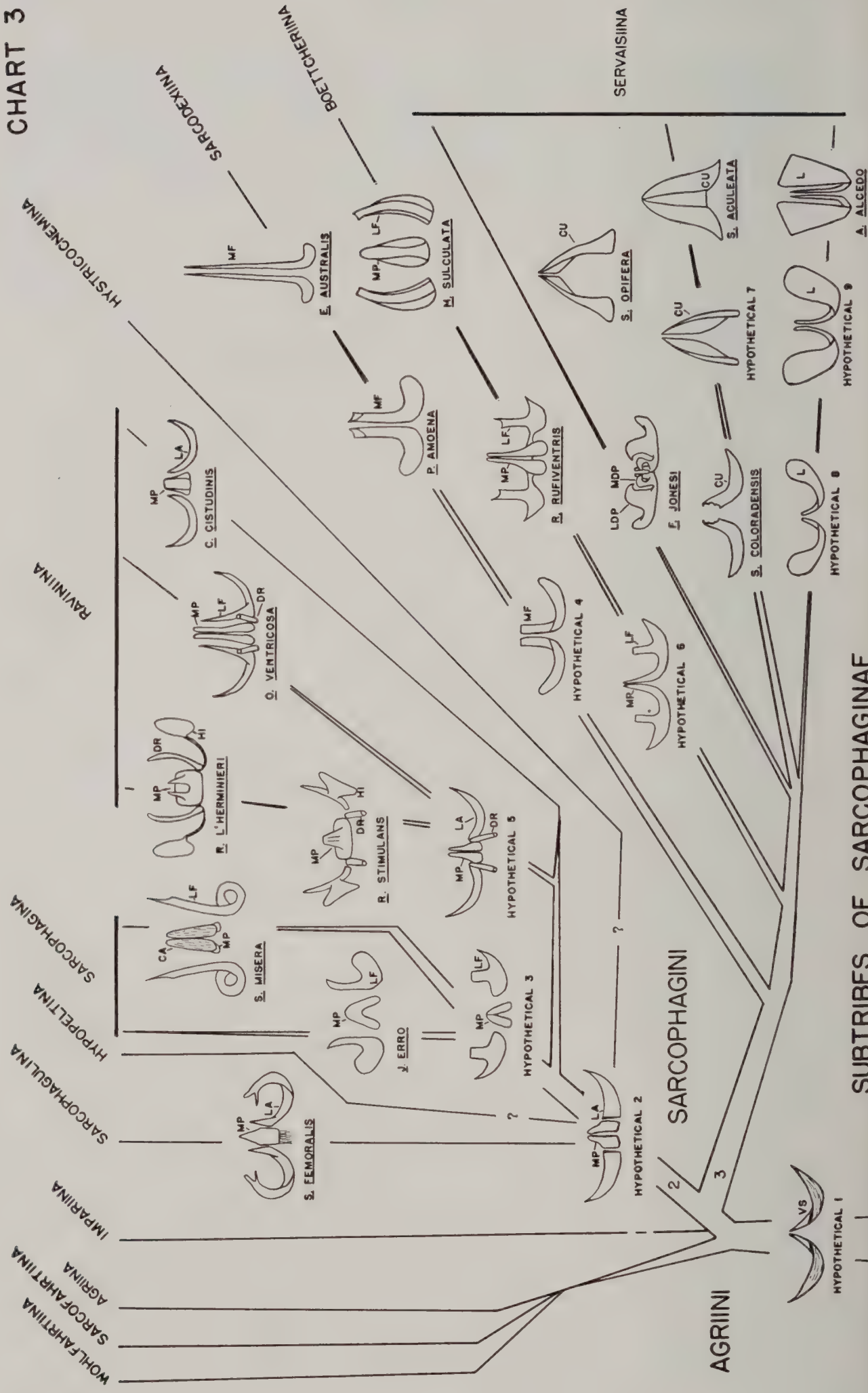
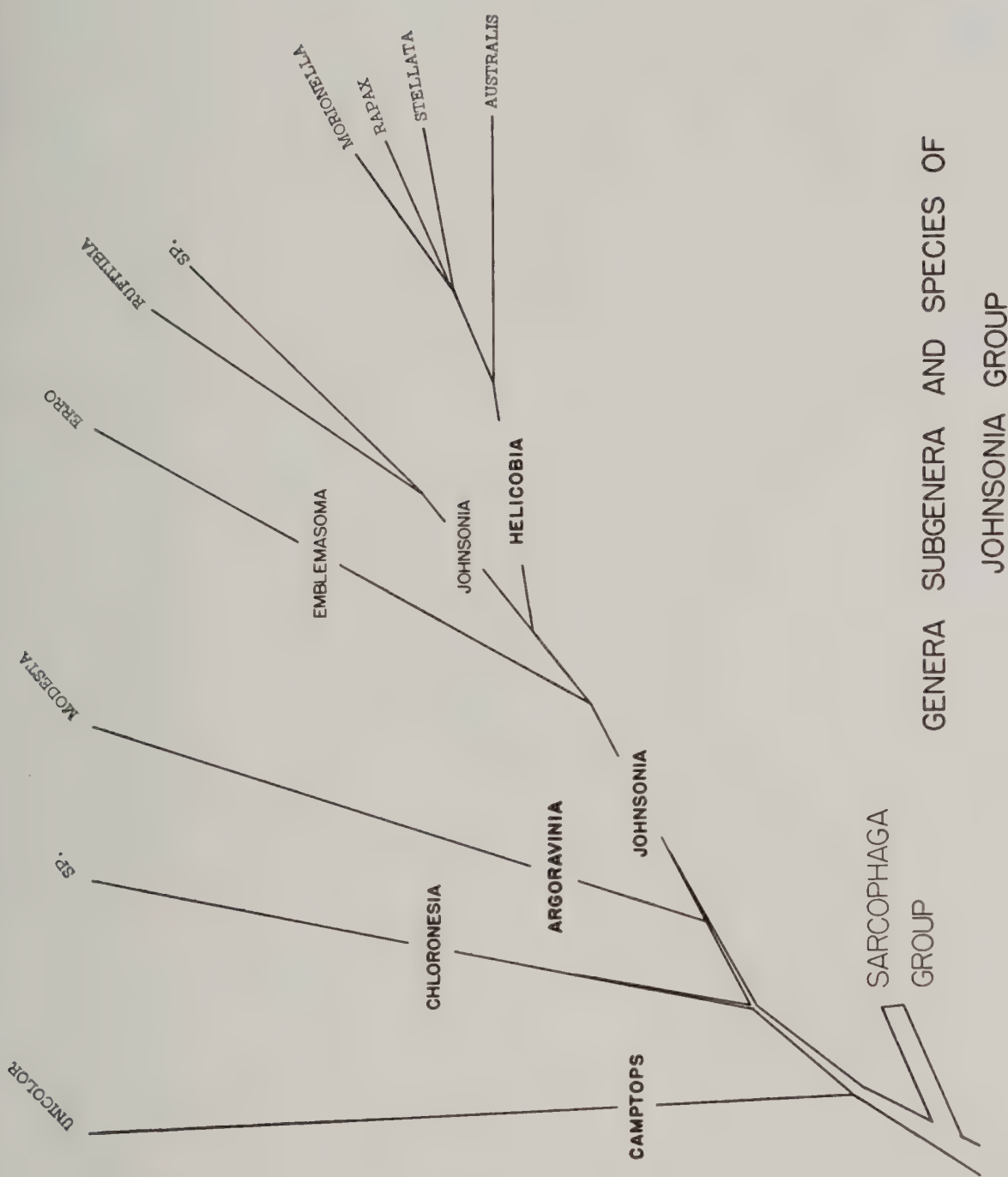


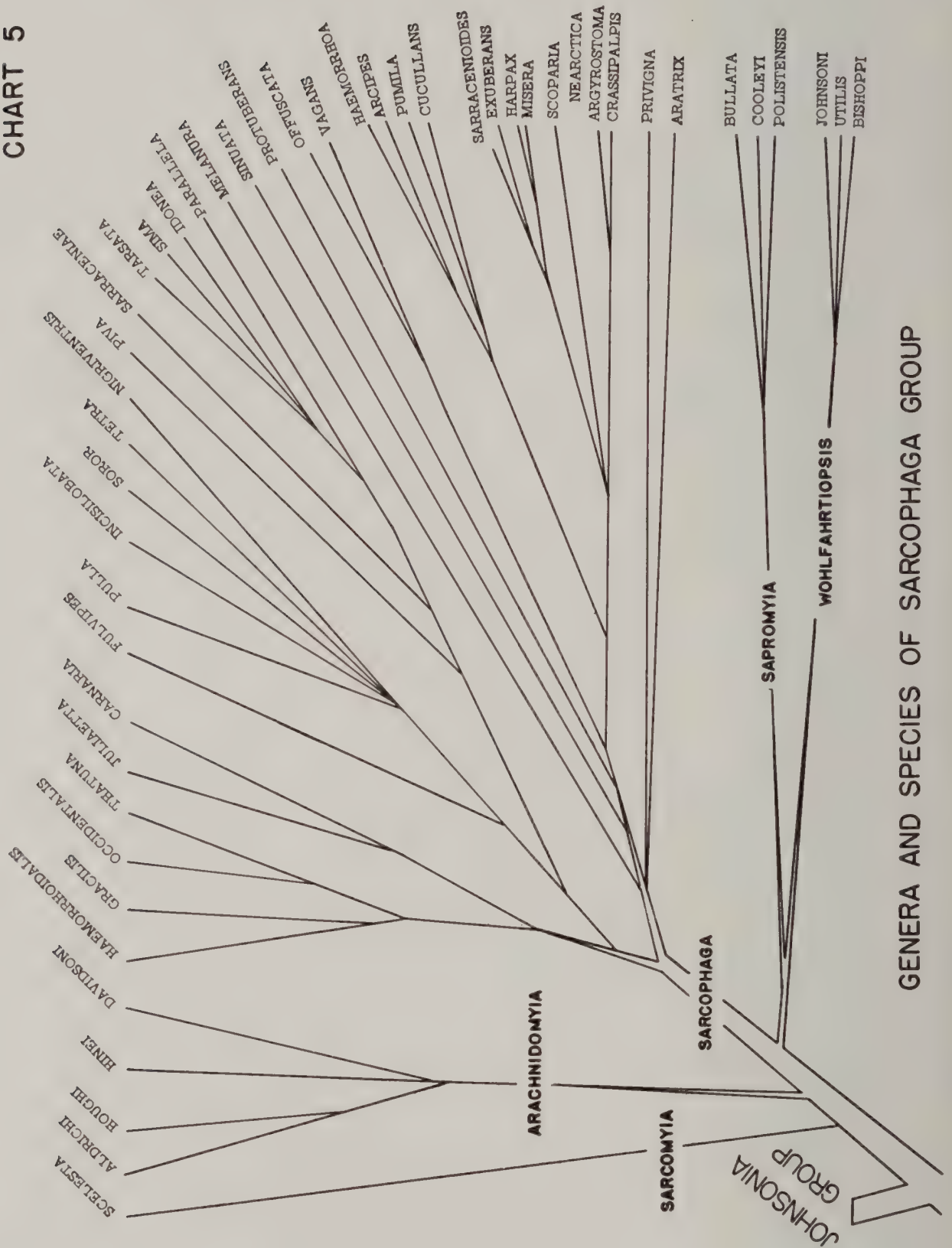


CHART 4



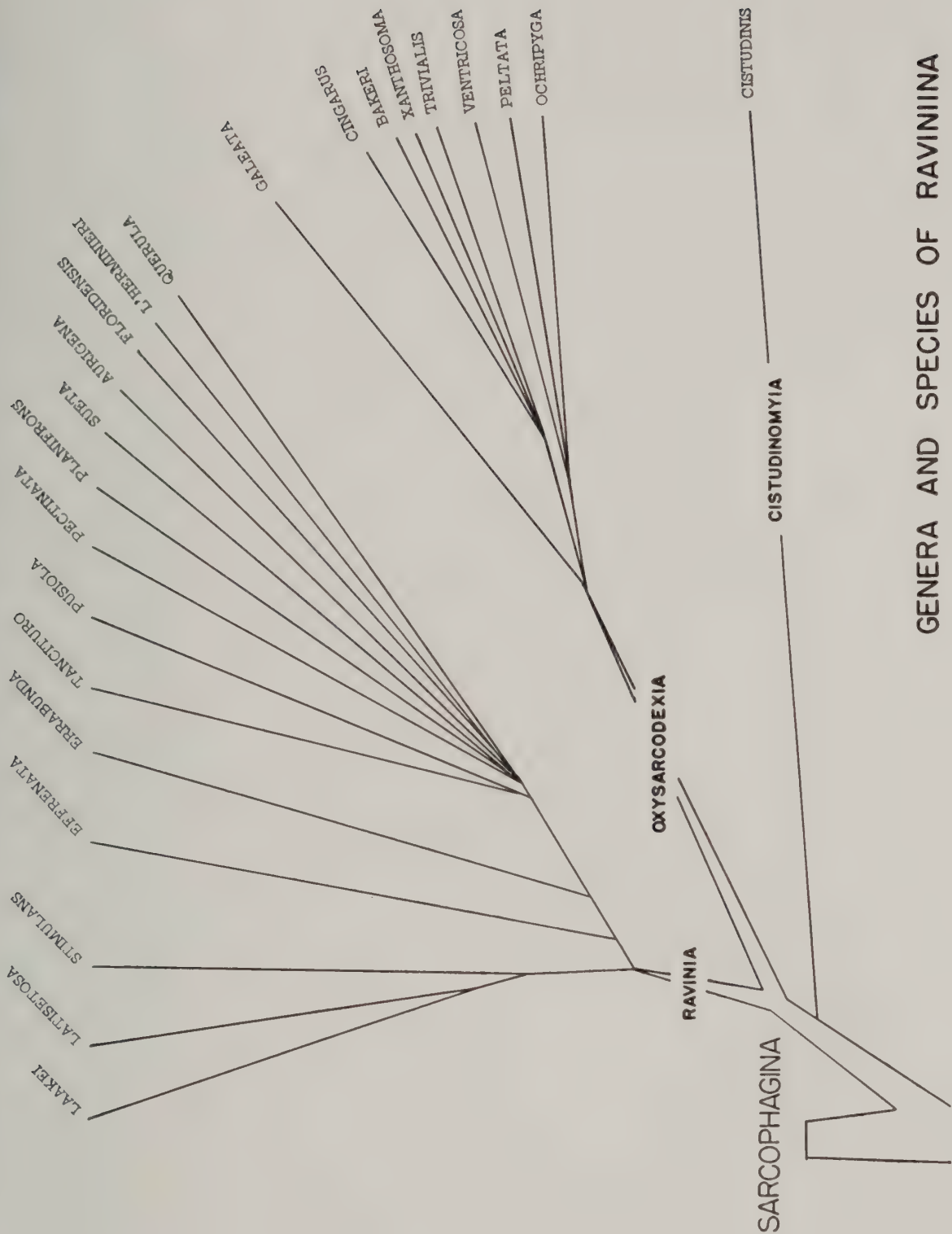
GENERA SUBGENERA AND SPECIES OF  
JOHNSONIA GROUP

CHART 5



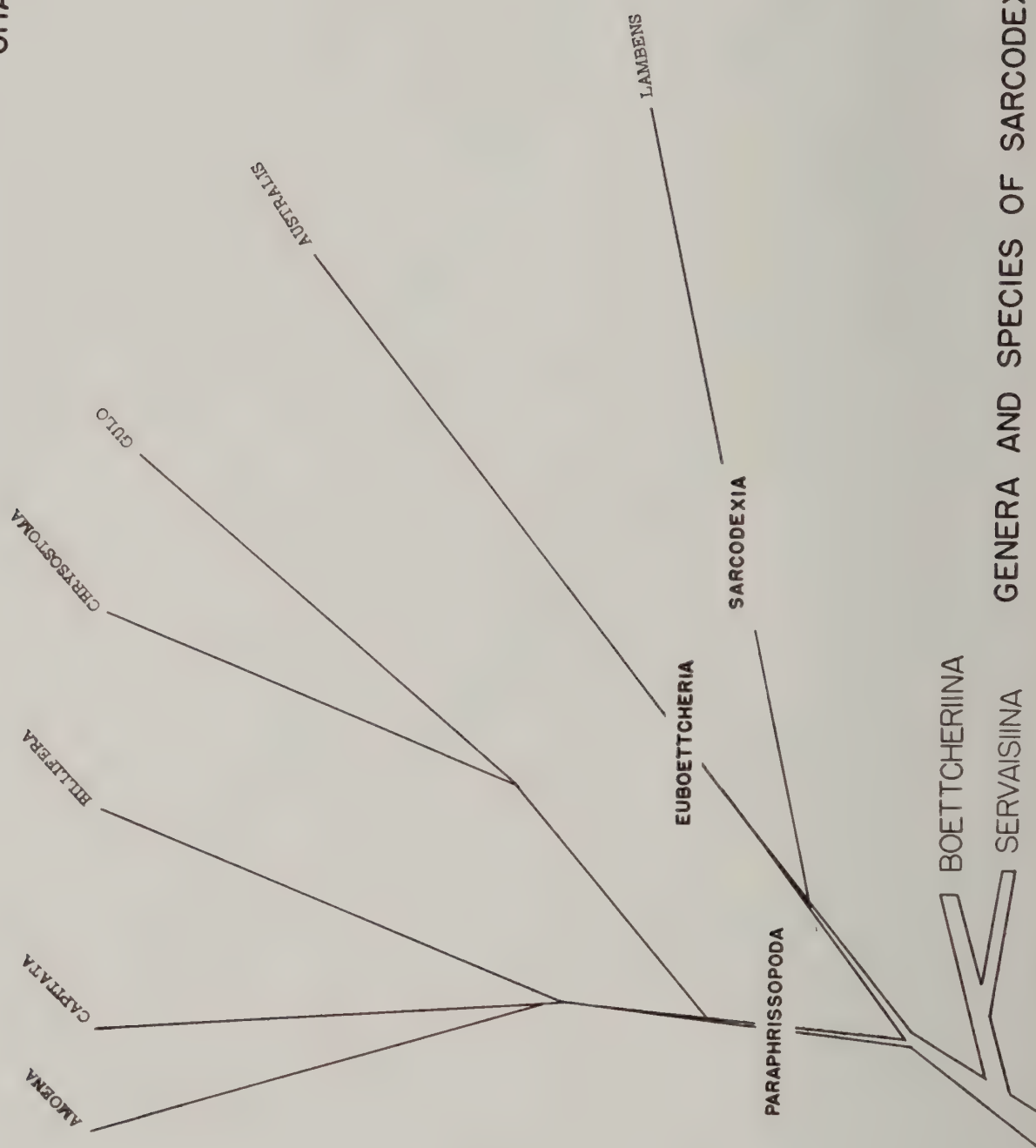
GENERA AND SPECIES OF SARCOPHAGA GROUP





GENERA AND SPECIES OF RAVINIINA

CHART 7



GENERA AND SPECIES OF SARCOPHAGINAE



## SERVAISIINA

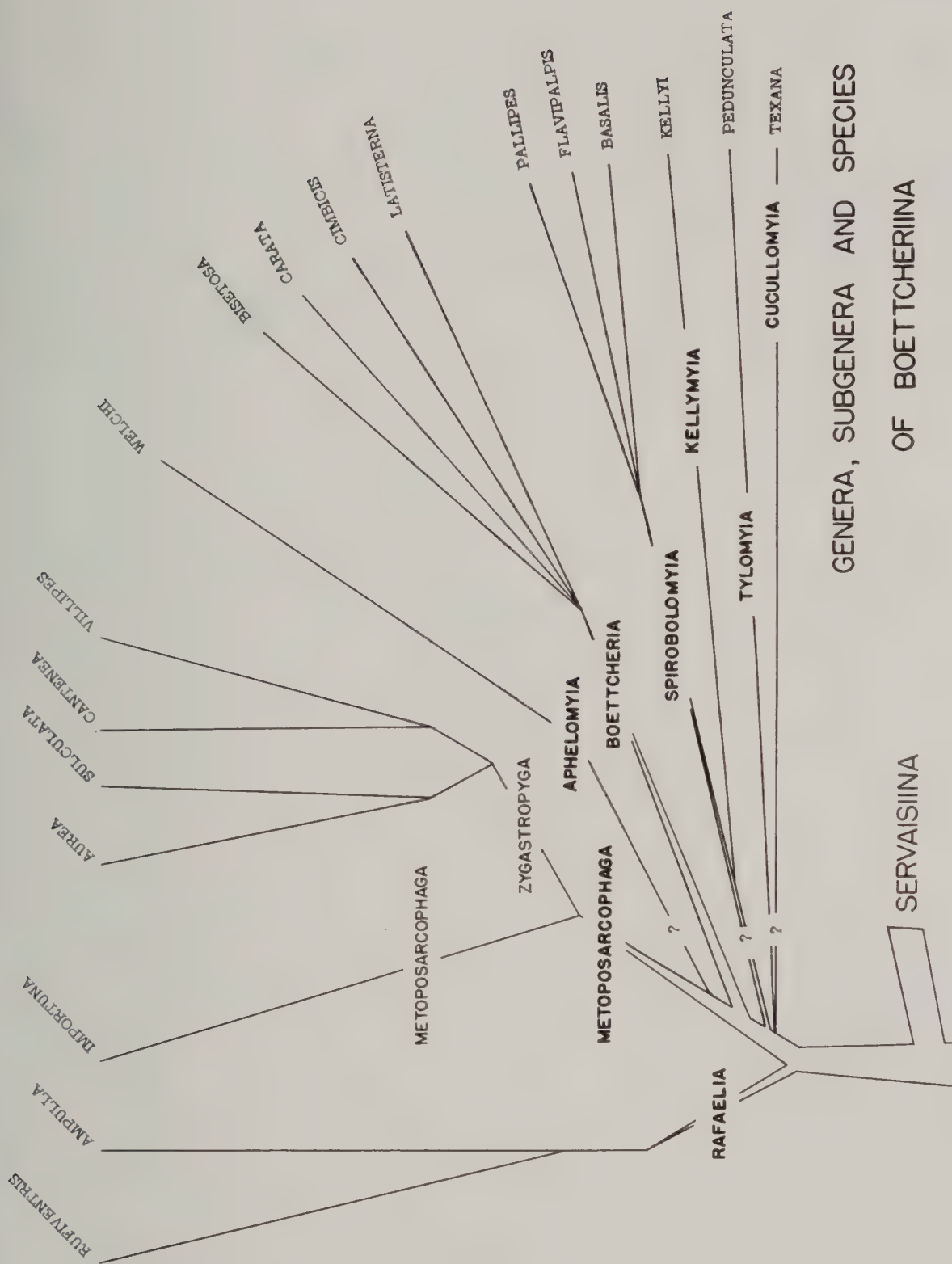
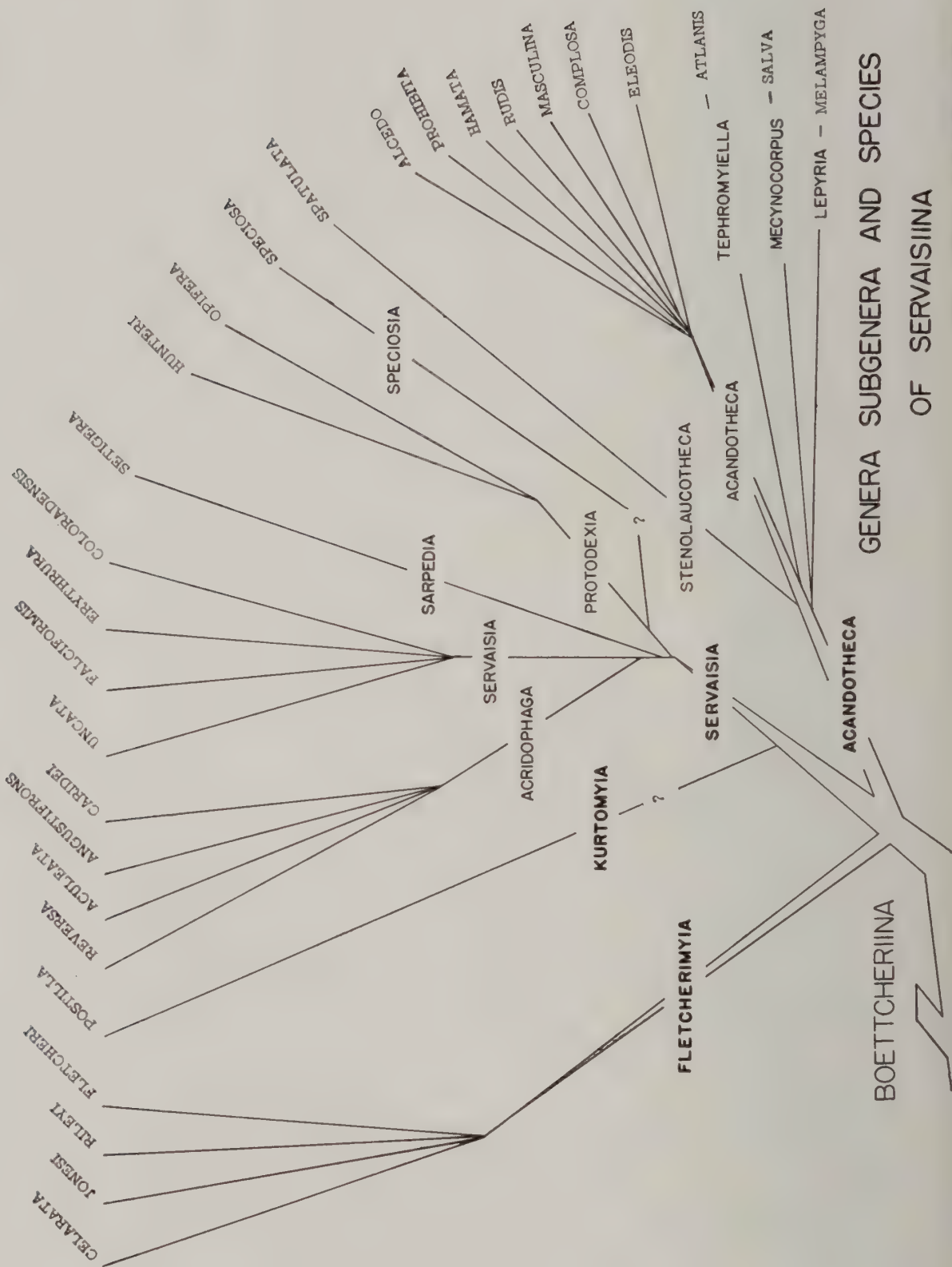


CHART 9



GENERA SUBGENERA AND SPECIES  
OF SERVAISIINA



## IV. Biogeography

It must be remembered that the conclusions and interpretations expressed here are tentative. Our knowledge of the sarcophagine fauna, though appearing extensive, is still very fragmentary for many parts of the world, and the views expressed here will undoubtedly be modified by the acquisition and consideration of new material.

Only the tribe Sarcophagini will be discussed here. There is too little material available on the tribe Agriini to enable any biogeographic conclusions to be drawn.

Two postulates presented by Ross and King (1951) are applicable here and should be kept in mind throughout the discussion:

1. If many species arise through geographic isolation, the least changed or primitive species should represent those still remaining in conditions most similar to the ancestral habitat; and the most changed should represent phyletic lines which have become adapted to conditions differing most from the ancestral.

2. That morphological change in male genitalia is correlated or associated with physiological change related to habitat.

Both these postulates are elaborated in the above-mentioned paper.

### ORIGIN AND GEOGRAPHIC CORRELATION

The most primitive Sarcophagini, those which most nearly approach the hypothetical ancestor in morphological details, are in the Caribbean region, centering around Central America. These are species such as *Camptops diversipes* (Coq.), *C. unicolor* Ald., and both species of *Sarcophagula* and of *Rafaelia*. All are located around the Caribbean. With postulate one in mind, we can therefore assume that Central America represents the area of origin for the Sarcophagini. The ancestral species evolved here and then apparently spread into North and South America.

The North American population of this imaginary ancestor probably gave rise to the subtribe Impariina, represented at present only by a single genus and species, *Imparia impar* (Ald.). This aberrant species is found only in the United States.

The distribution of the primitive members of Series 2 seems to indicate that the series arose in Central America in about the same region as the Sarcophagini ancestor. The primitive members of Series 2, *Sarcophagula* and *Camptops* spp., have changed less from the ancestral form

than the primitive members of either Series 1 or 3, and are distributed around the Caribbean.

The most primitive members of Series 3, *Rafaelia rufiventris* Tns. and *R. ampulla* (Ald.), are distributed in the southern United States and Mexico. The most generalized Sarcodexiina are circum-Caribbean and West Indian in distribution, and the Servaisiina are essentially Palearctic and Nearctic in distribution. All this would indicate southwestern North America or just south of it as the region of origin for Series 3. In the United States and South America, more specialized members of all three subtribes are found.

After its origin, the Series 2 ancestor spread into North and South America. Near its point of origin it gave rise to the progenitor of *Sarcophagula* which has remained restricted to the Caribbean area.

Later, the North American segment gave rise to the lines of the Raviniina. The most generalized members of this subtribe, *Ravinia stimulans* (Walk.), *R. latisetosa* Parker, *R. laakei* (Hall), and *Cistudinomyia cistudinis* (Ald.) are North American and West Indian in distribution. The species of the genera *Ravinia* and *Oxysarcodexia* which arose from this line spread back down into South America and are well represented there by specialized forms. *Oxysarcodexia* is the predominant genus of Sarcophagina in southern Brazil. Existing species of *Cistudinomyia* are restricted to North America.

In northern South America, the Series 2 ancestor gave rise to the ancestor of the Sarcophagina. The most primitive species of the Sarcophagina, *Camptops* spp. and *Chloronesia* spp., are distributed around this area. *Chloronesia* is predominantly a South American genus.

The next step in the evolution of Series 2, apparently, was the spread of the Sarcophagina ancestor into North America. The *Sarcophaga* group arose from it in North America, while the *Johnsonia* group arose from its South American segment.

Up to this point it seems that the populations of these various ancestors and groups had been able to spread up and down the Central American bridge, into North and South America, but now we come to a group which apparently was not able to spread into South America. This is the *Sarcophaga* group. This group is world-wide in distribution at present and is the generally predominant Sarcophagina group. It is, however, very poorly represented in South America, and some of the present records are obviously due to introduction by commerce.

The above fact, plus the presence of many generalized forms of the *Sarcophaga* group in North America, suggest this area as the place of origin of the group.

The most primitive members of the *Johnsonia* group are predominantly



South American and seem to indicate that the *Johnsonia* group arose there. Northern South America is probably the area of origin.

As postulated previously, the present distribution of the species of Series 3 indicates that southwestern North America represents the ancestral habitat and probably also the point of origin for the Series. From this area the ancestor of Series 3 spread into South America.

The most primitive existing Boettcheriina are located in the southern United States and Mexico, and on this basis we can likewise assume that this was the area in which the Boettcheriina arose. This subtribe has since spread into the northern United States and Canada, and down into South America. It is represented by several specialized genera in North America.

The Sarcodexiina, on the other hand, probably arose in Central America or northern South America. The most primitive species of the subtribe, those of the genus *Paraphrissopoda*, are located in Central America, northern South America, and the West Indies. A few species have been recorded from Florida. From this distribution we can infer that this subtribe arose in the south Central America or northern South American area. Specialized species of this subtribe are found southward into Chile and northward into the southern United States.

The area of origin of the Servaisiina cannot be definitely placed at present. Insufficient material was seen or was available in the literature to make possible the assignation of the Servaisiine ancestor to any specific area. Its primarily northern distribution, Nearctic and Palearctic, does suggest that it arose in the Northern Hemisphere.

The above conclusions have been drawn on the basis of the material examined and those species which could be definitely placed on the basis of figures or descriptions in the literature. There is a need for more collection and study—especially in the Ethiopian and Australian regions. The sarcophagine fauna of both these regions is far from well known, and a better understanding of the integration of their fauna with that of the rest of the world would add much to our understanding of the origin and distribution of the Sarcophagini.

There are so many groups whose center of origin seems to be Central or South America, that it seems possible to suggest that they arose after the period in the Cretaceous when there was free interchange of subtropical faunas between the New and the Old World. This would give a lower limit to the origin of these groups.

The several alternating periods of free interchange and isolation between North and South America during the Cenozoic undoubtedly contributed to speciation and the differentiation of groups.

If this were true, it would indicate that most of the genera of the Sar-

cophagini were of Miocene origin or even later, which would make them relatively young as compared to some of the more primitive insect groups. It would not, however, preclude the possibility that a few arose in the Oligocene or even earlier.

At what time the Sarcophagini became a world-wide northern group is not clear—it was perhaps in the Eocene or Miocene. The *Sarcophaga* group with its broad distribution and abundant fauna is perhaps the key to this problem. It must be examined and considered on a world-wide basis and the details of its evolution worked out.



## V. Nutritive Evolution

As can be seen from a perusal of the records in the literature, the Sarcophaginae have a great variety of nutritive habits. These range from saprophagous and coprophagous to human parasitism, very often within a single species. For example, *S. sarracenioides* has been reared from garbage and as a parasite of grasshoppers, and *S. haemorrhoidalis* from dung, as a parasite on insects, and as a human intestinal parasite. These examples are not unique in the Sarcophaginae. Most of the major lines of the Sarcophaginae show a great range of nutritive habits and are not specialized in any particular way. The Wohlfahrtiina and the Servaisiina are exceptions to the above statement. The members of the Wohlfahrtiina are, as far as known, all parasitic on a great variety of animals, while most of the Servaisiina are parasites of grass-land Orthoptera. Only the *Sarracenia*-dwelling members of *Fletcherimyia* are exceptions to this. The females of the parasitic Servaisiina have developed a spatulate ovipositor not found in other Sarcophaginae. It is interesting to note that in spite of the diversity of nutritive habits, the eggs and larvae of the Sarcophaginae are remarkably uniform in their morphology.

When we compare the nutritive habits and the lack of distinctive egg and first instar larval types in the Sarcophaginae with the nutritive habits and egg and first instar larval types in such entirely parasitic groups as the Larvaevoridae and Parasitoid Hymenoptera, we can see that the Sarcophaginae are, ecologically, what might be called a transition group, undergoing the change from coprophagous and saprophagous nutrition to pure parasitic nutrition.

Both the Larvaevoridae and Parasitoid Hymenoptera are entirely parasitic and have developed specializations not present in the Sarcophaginae. The Larvaevoridae have developed four egg types and three first instar larval types, and the Parasitoid Hymenoptera have developed five egg types and fourteen first instar larval types. As mentioned before, the eggs and first instar larvae of the Sarcophaginae are so similar throughout that no types have been distinguished. The reproductive capacity of the members of the Sarcophaginae is lower than that of either of the other two groups.

There are many vertebrate groups whose fossil record indicates that they have undergone a change in nutritive habit. A few examples will

illustrate the change in nutrition and the corresponding morphological changes.

The horse in 60,000,000 years, from *Hyracotherium* to *Equus*, has changed from a browser to a grazer. This change has been accompanied by changes in dentition, skull proportions, etc.

The perfection of the carnivorous habit from the Creodonts to the extant Carnivora in about 69,000,000 years was accompanied by great changes in the teeth and head.

Among the reptiles, the Procolophonids, in changing from a carnivorous to a herbivorous habit (30,000,000 years), underwent such changes as:

1. Shortening of the lower jaw.
2. Loss of teeth.
3. Formation of teeth into opposed grinding chisels.

Still more examples could be cited to show that in vertebrate evolution a change in food habit is accompanied by morphological change in the animal.

If our estimates of the age of the Sarcophaginae is correct, it has been evolving for about 45 to 70 million years, about as long as most of the above groups. In all this time, through all the fossil forms which must have existed, the Sarcophaginae have failed to develop any morphological change in the mechanism of food intake to correlate with the change in nutritive habit they are undergoing. The egg, larvae, and adult show no significant changes. The male aedeagus has changed (see plates), and we depend on this for our species groupings and phylogeny, but these changes have not always kept pace with food habit changes. We are, therefore, led to assume that the change in the Sarcophaginae must be physiological rather than morphological. This is not to imply that no physiological change has taken place in the vertebrates. Both have taken place there.

The Sarcophaginae, in retrospect, present the picture of a group—emerging at the end of the Cretaceous—evolving with diverse aedeagal forms and into a great range of food habits, without any correlated change in feeding apparatus of either larvae or adults but probably with great physiological change.



## VI. Classification

The classification of the Sarcophaginae presented in this section is based upon the opinions and conclusions drawn in regard to the phylogeny of the species treated here and the homology of their phallic structures.

No attempt has been made to write keys to the larger phylogenetic groupings used in this paper. They are large, broad groupings which do not lend themselves to easy key construction. Instead, a synopsis of tribes and subtribes has been prepared to show the important characters and relationships of the larger groupings. It is not a key for the identification of specimens. Also, a key to all the new and old genera (based on males) which are treated here has been constructed.

In the key to genera, external characters have been used as much as possible. However, in some groups the external features do not offer any good key characters, and male genital characters have been used. The genital characters, though more difficult to use, are more reliable than external characters and are the final arbiters in doubtful cases.

The key is primarily designed to separate the genera occurring in the Nearctic region, but Neotropical material belonging to the genera treated here will in most cases key out satisfactorily.

The descriptions are based mostly on specimens seen.

### LISTS AND ABBREVIATIONS

After each generic or subgeneric description there is a list of the species included in it. After the species name, authority, and date there are letters indicating the general distribution of the species and whether that species has been seen by the author or is definitely or tentatively placed in that genus on the basis of figures or descriptions in the literature. The last column contains a citation to the paper in which a good figure or description of the species can be found. The following abbreviations will be used.

S—Seen by author.

D—Definitely placed on the basis of good figure or description in the literature.

T—Tentatively placed on the basis of evidence in the literature.

## Distribution:

A—Australian region.

E—Ethiopian region.

O—Oriental region.

Oc—Oceanic region.

Ne—Nearctic region.

No—Neotropical region.

P—Palearctic region.

## SYNOPSIS OF TRIBES AND SUBTRIBES—MALES

1. Fifth sternite entire, Figs. 10, 16, 17, membrane between morphological fifth and seventh abdominal segments short; arista pubescent or short plumose ..... **Agriini**—2  
 Fifth sternite V- or Y-shaped, Figs. 35, 43, 85, membrane between morphological fifth and seventh abdominal segments long; arista long and plumose ..... **Sarcophagini**—4
2. Abdomen with median and lateral shining spots; spots sometimes slightly confluent; phallic tube reduced; Figs. 17-19; arista pubescent ..... **Wohlfahrtiina**  
 Abdomen not as above; generally pollinose; phallic tube well developed, Figs. 13, 14; arista short plumose ..... 3
3. Corpus rounded apically, Fig. 14; ventral sclerotization not clearly defined; phallic tube may be very long, Fig. 14; costal spine present ..... **Sarcophahrtiina**  
 Corpus extended anteriorly at apex, Fig. 13; ventral sclerotization greatly enlarged; phallic tube about one-half as long as above, Fig. 13; costal spine absent ..... **Agriina**
4. Phallus asymmetrical; large phallic tube present, Figs. 20-23 ..... **Impariina**  
 Phallus not as above; phallic tube, if present, much reduced and not easily seen ..... 5
5. Ventral sclerotization undergoes direct modification; no division... 6  
 Ventral sclerotization undergoes division, forms 3 parts ..... 7
6. Limen, Figs. 419-420, cunabula, Figs. 384, 390, 406, and stemmatis, Figs. 366-370, formed, except *A. postilla* (Rein.); corpus tubular and generally short; fifth sternite with window and short base; female with spatulate ovipositor; explanate vesica generally present; 3 or 4 posterior dorsocentrals; anterior acrosticals generally present; scutellars 2 or 3-1-1; \* hind tibiae bare; third abdominal segment with median marginals, see Figs. 366-441 ..... **Servaisiina**  
 Median filaments formed; corpus, if tubular, greatly elongate; fifth sternite with long narrow arms; vesica may be present; female not

\* Scutellar bristles are given in the following order: lateroscutellars—discoscutellars—apicoscutellars.



- with spatulate ovipositor; hind tibiae generally villous; 4-6 posterior dorsocentrals; anterior acrosticals generally absent; see Figs. 289-307 . . . . . **Sarcodexiina**
7. Large median process and spinose lateral filaments formed; fifth sternite without window; very wide and shallow; anal forceps, in lateral view, bipronged vertically; anal forceps as wide or wider than high; 5 posterior dorsocentrals; see Figs. 281-284. . **Hystricocnemina**  
Not with above combination of characters . . . . . 8
8. Phallus almost horizontal; boat-shaped; juxta small and partially concealed; lateral filaments and median process very small; vesica fused, turned upward; sail-like; 3 posterior dorsocentrals; no anterior acrosticals, Figs. 30-32 . . . . . **Hypopeltina**  
Phallus and lateral filaments and median process not as above; vesica generally free . . . . . 9
9. Two notopleurals; fifth sternites small and shallowly notched; lateral arms barely modified; no juxta; large vesica; proclinate fronto-orbitals present in both sexes; genitalia as in Figs. 24-29 . . . . **Sarcophagulina**  
Two to 4 notopleurals; fifth sternite generally larger and more deeply notched; lateral arms modified; if simple they have moved upward; juxta present or absent; proclinate fronto-orbitals generally present only in females . . . . . 10
10. Juxta absent, except *R. effrenata* (Walk.); phallus and phallopore fused; corpus partially or entirely closed over ventrally; dorsal rods present in *Ravinia* and *Oxysarcodexia*; 3-5 posterior dorsocentrals; anterior acrosticals generally present; apical scutellars generally absent; Figs. 215-280, 285-287 . . . . . **Raviniina**  
Juxta present; phallus and phallopore generally free; corpus not closed over ventrally; lateral filaments and median process present . . . . . 11
11. Median process fused to juxta; division of ventral sclerotization takes place before modification; capitis, harpes, small sclerous lateral plates, and a rudimentary phallic tube may be present; 2 to 6 posterior dorsocentrals; Figs. 33-214 . . . . . **Sarcophagina**  
Median process free; division takes place after modification; capitis and other parts above, never present; 3 to 5 posterior dorsocentrals; genitalia as in Figs. 308-365 . . . . . **Boettcheriina**

The above synopsis shows the characters and relationships of the tribes and subtribes of Sarcophaginae. It is not for identification of specimens.

KEY TO GENERA—MALES

1. Fifth sternite entire; membrane between morphological abdominal segments 5 and 7 short; arista bare or pubescent . . . . . 2

- Fifth sternite V- or Y-shaped; membrane between morphological fifth and seventh abdominal segments long, Text Fig. 1; arista generally plumose .....4
2. Abdomen with three rows of black spots; spots may be confluent, Fig. 448 ..... **Wohlfahrtia**  
 Abdomen with grey and black checkered pattern, tessellated; pattern shifting with light angle..... 3
3. Costal spine present but small; phallic tube may be long, Fig. 14; anal plate and forceps distant from each other, Fig. 449, or anal plate may appear fused to ninth tergum ..... **Sarcofahrtia**  
 Costal spine absent; phallic tube short; ventral sclerotization very large; Figs. 11-13 ..... **Agria**
4. First vein bare .....5  
 First vein setulose .....35  
 First and fifth veins setulose ..... **Johnsonia** (pt.)
5. Aedeagus asymmetrical; large phallic tube present, Figs. 20-23; anal forceps as in Fig. 451 ..... **Imparia** n. gen.  
 Aedeagus symmetrical; large phallic tube not present .....6
6. Anal forceps bipronged vertically, Fig. 453; prongs equal in length; forward prong with hook; aedeagus as in Figs. 281-284.....  
 ..... **Hystricocnema**  
 Anal forceps not bipronged as in Fig. 453; if slightly bipronged, prongs are never equal, Fig. 456, and anterior prong not with sharp black hook .....7
7. Posterior lateral clasper black, tubular, turned outward; anterior clasper with ventral row of bristles; phallus as in Figs. 30-32.....  
 ..... **Hypopelta**  
 Posterior lateral clasper not black and tubular; generally turned anteriorly, never outward; anterior clasper not with ventral row of bristles; phallus not shaped as in Figs. 30-32 .....8
8. Large patches of yellow-brown hair below latero-scutellars; phallus as in Figs. 362-365 ..... **Cucullomyia** n. gen.  
 No such patches of hair present; phallus not as above .....9
9. Genital segments large and protuberant, Fig. 460; abdomen may have truncate appearance caudally; anal plates generally large, may be longer than anal forceps, Fig. 334; phallus smooth and capsule-like, Figs. 316, 327-336; phallophore extended hook-like, caudally, at base ..... **Metoposarcophaga** (pt.)



- Genital segments not large and protuberant as above; anal plates generally smaller, oval or triangular in shape; never longer than anal forceps; phallus not shaped as above .....10
10. Phallus generally turned caudad from phallophore; corpus smooth, small, barrel-shaped; vesica plume-like; Figs. 330-332 .....  
..... **Aphelomyia** n. gen.  
Phallus not generally turned as above; corpus not small, smooth and barrel-shaped; vesica not as above .....11
11. Phallus of type shown in Fig. 41; lateral arms of fifth sternite with mesal expansions, beginning about half way to apex and tapering to apex, Fig. 42; oral vibrissae at oral margin; abdomen with metallic sheen; 2 or 3 posterior dorsocentrals .....**Chloronesia**  
Phallus not as in Fig. 41; if lateral arms with mesal expansions [(*J. (Emblemasoma) erro*)] then oral vibrissae above oral margin and approximated; abdomen not with metallic sheen .....12
12. Two notopleurals; third abdominal segment with row of bristles; fifth sternite small and weakly indented, Fig. 24 .....13  
Three or 4 notopleurals; fifth sternite larger and more deeply indented, Fig. 47 .....14
13. Discoscutellars present; vesica large and distinct; juxta absent; abdominal stripes black; phallus, Figs. 24-29 .....**Sarcophagula**  
Discoscutellars absent; vesica membranous, not large; juxta present; abdominal stripes brown; phallus, Figs. 34-36 .....**Camptops** (pt.)
14. Oral vibrissae above oral margin, approximated; genitalia as in Figs. 45-47 .....**Johnsonia** (pt.)  
Oral vibrissae at oral margin; genitalia not as above .....15
15. Frontal row very strongly divergent in last 4 or 5 bristles; 3 posterior dorsocentrals; anal forceps short; generally with basal tuft of hair; anal plate generally inverted L-shaped, Fig. 450; Figs. 337-349.....  
..... **Boettcheria**  
Frontal row not as above; if strongly divergent, then 4 to 6 posterior dorsocentrals present; anal forceps not as above .....16
16. Phallophore and phallus fused; phallus partially or entirely closed over ventrally; apical scutellars generally lacking .....17  
Phallophore and phallus free; phallus not closed over ventrally; apical scutellars generally present .....19
17. Third abdominal segment with marginal row of 20 bristles; anterior acrosticals barely differentiated; genitalia, Figs. 286-287.....  
..... **Cistudinomyia**

- Third abdominal segment with median marginals at most; anterior acrosticals generally well differentiated .....18
18. Vesica simple, flap-like; hillae present; genitalia, Figs. 233-255....  
..... **Ravinia**  
Vesica large and complex; hillae absent; genitalia, Figs. 256-280...  
..... **Oxysarcodexia**
19. Juxta large and forked, Fig. 302; gives phallus appearance of inverted Y; median filaments present .....**Sarcodexia**  
Juxta not forked as above .....20
20. Juxta with caudally projecting copi, Figs. 428-441; anal forceps as in Fig. 456 .....**Acandotheca** (pt.)  
Copi not present, if juxta is present .....21
21. Anal forceps short; reverse L-shaped, Fig. 458; bulbous at bend of L; corpus with lateral hooks at apex; paired semi-sclerous plates present on each side of corpus; cunabula present; Figs. 411-412....  
..... **Servaisia** (pt.)  
Anal forceps not as above; corpus not with hooks .....22
22. Stemmatis present; juxta consists of a pair of large, soft, light-colored and delicately haired lobes; explanate vesica large and well sclerotized; stemmatis often projecting anteriorly; Figs. 366-376....  
..... **Fletcherimyia**  
Stemmatis not present; juxta not as above; explanate vesica, if present, not as large and more membranous .....23
23. Anal forceps variably indented at base, Fig. 456; tip turned forward; generally some spines or hairs at bend; corpus semi-tubular; variable in length; cunabula or limen present; explanate vesica may be present .....24  
Anal forceps not as above; corpus not semi-tubular; cunabula and limen not present .....26
24. Large scoop-shaped juxta present; bears large limen dorsally; Figs. 416-418 .....**Acandotheca** (pt.)  
Juxta, if present, not shaped as above .....25
25. Short tubular limen present at tip of corpus; higher than wide with hook below; appears as a vertically placed rectangle in profile; explanate vesica present; Fig. 414 .....**Acandotheca** (pt.)  
Limen not present; juxta, if present, bifurcate with spatulate tips or completely divided at base, Figs. 384, 386, 392, and 403, 406; cunabula present; membranous explanate vesica generally present; Figs. 380-407 .....**Servaisia** (pt.)



26. Corpus, in lateral view, thin and blade-like; curved forward apically; partially or completely bifurcate at apex, Figs. 308, 309, 410. . . . .27  
Corpus of various shapes; never blade-like in profile . . . . .28
27. With large vertically ovate plates present on either side of corpus; anal forceps sharply hooked near tip, Fig. 452; Figs. 308-309. . . . .  
 . . . . . **Kellymyia**  
Lateral plates not present; forceps not as above; divided vesica present; Fig. 410 . . . . .**Kurtomyia** n. gen.
28. Corpus large; hooked apically; shaped as reversed K; large, foliate, semi-sclerous lateral plates present; Figs. 350-361. . . .**Spirobolomyia**  
Corpus not shaped as above; lateral plates not present. . . . .29
29. Corpus and juxta continuous in contour, forming a claw-shaped structure; vesica bent vertically at its mid-point; Figs. 79-81. . . . .  
 . . . . . **Sarcomyia** n. gen.  
Corpus not shaped as above . . . . .30
30. Vesica consists of two ovate ventrally spinose lobes; Figs. 90-102; juxta small and free . . . . .**Sapromyia** n. gen.  
Vesica, if divided, not spinose as above . . . . .31
31. Median filaments present; fifth sternite with long arms and a short sternal base; juxta absent; posterior dorsocentrals 3 small—2 large; discoscutellars generally lacking . . . . .32  
Median filaments not present; fifth sternite generally with longer base; juxta present; 3 to 6 posterior dorsocentrals; discoscutellars generally present . . . . .33
32. Vesica present; corpus robust; Figs. 288-301 . . . . .**Paraphrissopoda**  
Vesica absent; corpus elongate, tubular at base; Figs. 305-307. . . . .  
 . . . . . **Euboettcheria**
33. Vesica large and of bizarre shape; as long as corpus; capitis elongate, projects from within corpus; almost detached from median process; anal forceps stout with brush of hair on outer side near tip, Fig. 459; corpus often coated with yellow mass, Figs. 82-89. . .**Wohlfahrtiopsis**  
Vesica and capitis not as above; anal forceps without brush near tip; yellow mass not present . . . . .34
34. Hind tibiae bare; harpes never blade-like; juxta short and broadly attached to corpus; median process placed anteriorly on juxta; capitis generally sclerous; 3 or 4 posterior dorsocentrals, Figs. 70-77. . . . .  
 . . . . . **Arachnidomyia**  
Hind tibiae generally villous; harpes may be elongate and blade-like or very large; median process placed posteriorly on juxta; capitis

- membranous or sclerous; 3 to 6 posterior dorsocentrals; Figs. 103-214 ..... **Sarcophaga**
35. Two notopleurals; male with proclinate fronto-orbitals; genitalia, Figs. 34-36 ..... **Camptops** (pt.)  
 Three or 4 notopleurals; male without proclinate fronto-orbitals...36
36. Phallus and phallophore fused; hillae present; Figs. 211-231.....  
 ..... **Ravinia** (pt.)  
 Phallus and phallophore separate; hillae absent.....37
37. Genital segments large and protuberant, Fig. 460; abdomen may have truncate appearance caudally; anal plates generally large, may be longer than anal forceps, Fig. 334; phallus smooth and capsule-like, Figs. 316, 327-336; phallophore extended hook-like, caudally, at base ..... **Metoposarcophaga** (pt.)  
 Genital segments not large and protuberant as above; anal plates generally smaller, oval or triangular in shape; never longer than anal forceps; phallus not shaped as above.....38
38. Second abdominal segment with median marginals; limen and explanate vesica present; Figs. 422-424..... **Acandotheca** (pt.)  
 Second abdominal segment without median marginals.....39
39. Lateral plates present, Figs. 48, 52, 58; no vesica present.....40  
 Lateral plates not present; vesica may be present.....41
40. Apical scutellars present; third abdominal segment generally with median marginals or a complete row; phallic tube absent; Figs. 52-62 ..... **Helicobia** (pt.)  
 Apical scutellars absent; without median marginals on third abdominal segment; phallic tube present; Figs. 48-51.....  
 ..... **Helicobia** (pt.)
41. Juxta thin and elongate in lateral view; corpus with pair of long lateral ribbon-like processes; Figs. 63-66..... **Helicobia** (pt.)  
 Juxta heavier; corpus not with pair of long lateral ribbon-like processes .....42
42. Frontal row broadly divergent in last three bristles; anal forceps strongly hooked in profile, Fig. 457; genitalia, Figs. 419-421.....  
 ..... **Acandotheca** (pt.)  
 Frontal row barely divergent in last bristle; anal forceps not shaped as above .....43
43. Three posterior dorsocentrals ..... **Rafaelia**  
 Four posterior dorsocentrals .....44



44. Anal forceps reddish-yellow, short, Fig. 455; free part directed ventro-caudad; Figs. 37-39 . . . . . **Argoravinia**  
 Anal forceps black, long; tip curved anteriorly, Fig. 454; short white hairs on either side of scutellum below lateroscutellars; Figs. 356-359 . . . . . **Tylomyia** n. gen.

## AGRIINI

## SUBTRIBE WOHLFAHRTIINA

This subtribe consists of the genus *Wohlfahrtia* only. The abdomen has three rows of spots, Fig. 448. These spots may be confluent. The phallic tube is generally reduced. See Chart 3.

Genus *Wohlfahrtia* Brauer & Bergenstamm

**Wohlfahrtia** Brauer & Bergenstamm 1889. Denkschr. Akad. Wien 56: 123. Genotype *Sarcophila magnifica* Schin.

**Agria** Macquart 1835 (nec. R.-D.). Suites a Buffon, II, 229, 3. Genotype *Tachina nuba* Wied. (teste Séguy, 1941b).

**Disjunctio** Pandellé 1894. Rev. Entom. 13:56. Genotype *Sarcophaga tetripunctata* Dufour equals *W. bella* Macq.

**Bracia** Enderlein 1934. S. B. Ges. Naturf. Fr. Berlin, p. 189. Genotype *Tachina nuba* Wied.

**Pandellea** Enderlein 1934. S. B. Ges. Naturf. Fr. Berlin, p. 189. Genotype *Wohlfahrtia hungarica* B. & B. equals *W. meigeni* Schin.

Front protuberant; arista bare or with very short hairs; frontal row not divergent; notopleurals two; sternopleurals two; apicoscutellars absent; anterior acrosticals variable; 3 to 5 PSDC; not all equal in strength; hind tibiae may have a short fringe; abdomen with three rows of black spots; may be confluent in some cases; 5S with margin entire, Fig. 17; phallus with apex closed over; appearing hollowed out in some species, Figs. 18, 19; forms wide or narrow trough; corpus may have projections on either side; phallic tube reduced, Figs. 18, 19, or moderately conspicuous.

The species of the genus *Wohlfahrtia* are present in all regions except the Neotropical and Australian. The genus is primarily Palearctic. The species are noted for their myiasis production in man. Walker (1920 and 1922), Johannsen (1921 and 1926), Felt (1924), Ford (1936), and others have studied the biology of some of the species of *Wohlfahrtia*. According to Séguy (1941b), Rohdendorf has recorded *W. trina* (Wied.) as a parasite of *Schistocerca gregaria* Forsk. Séguy (1941a) treats many of the species of this genus and their biology. Potgieter (1929) records *W. euvittata* Vill. as an egg parasite of *Locustana*.

Included Species		
<i>atra</i> Aldrich 1926	P	D (Aldrich 1926)
<i>bella</i> (Macquart) 1836	P	D (Salem 1938a)
<i>brunnipalpis</i> (Macquart) 1850	P	D (Salem 1938a)
<i>erythrocer</i> a Villeneuve 1931	P,E	D (Salem 1938a)
<i>euvittata</i> Villeneuve 1920	E	D (Salem 1938a)
<i>indigens</i> Villeneuve 1928	P	D (Patton 1939)
<i>indigens aethiopica</i> Villeneuve 1928	E	D (Salem 1938a)
<i>intermedia</i> (Portchinsky) 1887	P	D (Salem 1938a)
<i>magnifica</i> (Schiner) 1862	P	D (Patton 1939)
<i>meigeni</i> (Schiner) 1862	Ne,P	D (Salem 1938a)
<i>nuba</i> (Wiedemann) 1830	P,O,E	D (Patton 1939)
<i>pattoni</i> Salem 1938a	P	D (Salem 1938a)
<i>seguyi</i> Salem 1938a	E	D (Séguy 1941b)
<i>smarti</i> Salem 1938a	E	D (Salem 1938a)
<i>trina</i> (Wiedemann) 1830	P,E	D (Patton 1939)
<i>triquetra</i> Séguy 1931	P	D (Séguy 1941b)
<i>vigil</i> (Walker) 1849	Ne	S
<i>villeneuvei</i> Salem 1938a	P	D (Salem 1938a)

## SUBTRIBE SARCOFAHRTIINA

This subtribe contains the single genus *Sarcofahrtia*. The corpus is partially closed over ventrally, Figs. 14, 15, the phallic tube may be very long, Fig. 14, and the ventral sclerotization indistinct. Anal plate is distant from anal forceps, Fig. 449, may appear fused to ninth tergum.

Genus *Sarcofahrtia* Parker

*Sarcofahrtia* Parker 1916a. *Psyche* 23:131. Genotype *Sarcofahrtia ravinia* Park.

*Thelodiscus* Aldrich 1916. *Sarcophaga* and allies, p. 61. Genotype *Thelodiscus indivisus* Ald. equals *Sarcofahrtia ravinia* Park.

Frontal rows divergent over their entire length; outer verticals absent; 4+ post-ocular rows; 3 PSDC; anterior acrosticals absent; 2 notopleurals; scutellars 3-1-0; 2A with only laterals; 3A with MM; IV and hind tibiae bare; 5S as in Fig. 16; essential phallic characters given above.

All the species placed in this genus are North American. Their biology is unknown.

Included Species		
<i>atlantica</i> Parker 1919b	Ne	D (Parker 1919b)
<i>madisoni</i> Parker 1919b	Ne	D (Parker 1919b)
<i>montanensis</i> Parker 1919b	Ne	D (Parker 1919b)
<i>ravinia</i> Parker 1916a	Ne	S

## SUBTRIBE AGRIINA

This subtribe consists of the single genus *Agria* R. D. The abdomen here is normally tessellated and the ventral sclerotization is greatly enlarged and developed. See Chart 3.



Genus *Agria* Robineau-Desvoidy

*Agria* Robineau-Desvoidy 1830. Ess. Myod., p. 376. Genotype *Musca affinis* Fall.

*Pseudosarcophaga* Kramer 1908b. Ent. Woch., 25:200. Genotype *Musca affinis* Fall. designation by Enderlein 1928a.

Frontal rows very gradually divergent over entire length; outer verticals absent; 3 or 4 post-ocular rows; 3 PSDC; anterior acrosticals present; 2 notopleurals; scutellars 3-1-0; 2A with laterals only; 3A with MM; 1V bare; hind tibiae bare; 5S with margin entire; corpus opens ventrally, with anterior projections, Figs. 11-13; ventral sclerotization greatly enlarged with long lateral dorsal projections, Fig. 13.

The taxonomy of this genus is in a slightly confused state at present. Aldrich (1916) and Senior-White (1940) credit the genus to Robineau-Desvoidy with *Musca affinis* Fallén as type. Townsend (1937) also credits the genus to Robineau-Desvoidy but gives *A. punctata* R. D. equals *Musca latifrons* Fallén as genotype. The genotype designation was by Townsend (1916). Séguy (1941b) credits the genus to Macquart (1835) with *Musca affinis* Fallén as type.

The type species is Nearctic and Palearctic in distribution. It has been reared from *Vanessa antiopa* (Aldrich 1916) and other insects. Séguy (1932a) lists it as a grasshopper parasite, and Thompson (1943-47) lists it as a parasite on Tenthredinidae and Lymantridae. Other species that have been placed here were not available for study, and the descriptions were not sufficiently clear to place them here.

## SARCOPHAGINI

## Series 1

This is the most primitive of the series of the Sarcophagini. The characters given under the only subtribe and genus (*Impariina* and *Imparia* n. gen.) will suffice to define the series. See Chart 3.

## SUBTRIBE IMPARIINA

This is the most aberrant of all the subtribes of the Sarcophagini. The asymmetrical phallus is unique. Its primitive position, Chart 3, is due to the presence of a very large phallic tube. Such a tube is possessed by no other sarcophagid. Its external characters are not distinctive. It consists of only one genus.

Genus *Imparia* new genus

Frontal row divergent in last 2 bristles; outer vertical absent; 3 post-ocular rows; 4 or 5 PSDC, anterior 2 small; anterior acrosticals present; scutellars 2-1-1; 2A and 3A with laterals only; 1V and hind tibiae bare;

5S as in Fig. 23; phallus asymmetrical, Figs. 20-22; large phallic tube present; anal forceps very sharply hooked, Fig. 451.

Genotype and only species *Sarcophaga impar* Ald. by present designation.

The genotype is North American and has been recorded as a parasite and from beef refuse (Aldrich 1916) and has been reared from garbage by the author.

## Series 2

This series is characterized by the tripartite split of the ventral sclerotization before it undergoes modification. It is more primitive than Series 3 in habits, containing many coprophagous and saprophagous genera and species. Many of its species are capable of developing either as scavengers or as true parasites. The subtribe Sarcophagulina and the *Johnsonia* group contain some of the most generalized of the Sarcophagini. The genera *Camptops* and *Sarcophagula* both contain species with 2 notopleurals, proclinate fronto-orbitals in the male and very generalized phalli.

There are five subtribes in this series. They are Sarcophagulina, Hypopeltina, Sarcophagina, Raviniina, and Hystricocnemina. See Chart 3 for the relationships of these subtribes.

### SUBTRIBE HYPOPELTINA

This subtribe consists of the one genus *Hypopelta* Ald. Like *Imparia*, its phallus is unique among those of the Sarcophagini. The corpus is generally turned anteriorly, and is almost at right angles to the phallopore. The basally sclerotized section sends out two large plates which give the corpus a boat-like appearance. The dorsally projecting vesica is like a sail. It is probably an early offshoot of the sarcophagine-raviniine line, Chart 3, and is here given subtribal rank.

### Genus *Hypopelta* Aldrich

***Hypopelta* Aldrich 1916.** *Sarcophaga* and allies, p. 49. Genotype *Hypopelta scrofa* Ald.

Frontals diverging rapidly below; outer verticals present; 3 post-ocular rows; 3 PSDC; anterior acrosticals absent; scutellars 1-0-1, the apicals could be considered as laterals giving a 1-1-0 formula; 2A with only laterals; 3A with MM; abdomen large and clubbed apically; 5S with oval lobes on inner margins of sternal arms; posterior claspers black, tubular, turned outward; phallus as in Figs. 30-32.

The genotype, the only species, is North American. Its biology is not known.



## SUBTRIBE SARCOPHAGULINA

This is one of the most primitive of the subtribes of Sarcophagini. The fifth sternite is very small and generalized and the lateral arms are still attached to the corpus and have not moved from their original position. The retention of proclinate fronto-orbitals in the male and 2 notopleural bristles also place this subtribe in a rather primitive position. It has been placed as an early offshoot of the sarcophagine-raviniine stock, Chart 3. It consists of only one genus, *Sarcophagula* Wulp.

Genus *Sarcophagula* Van der Wulp

*Sarcophagula* Van der Wulp 1887. Tijdsch. V. Ent., 30:173. Genotype *Musca occidua* Fab. designation by Coquillett 1910.

*Sarothromyia* Brauer & Bergenstamm 1891. Zweifl. Kais. Mus. V, part 2:365. Genotype *Sarcophila femoralis* Schin.

Frontal rows not divergent; 1 or 2 proclinate fronto-orbitals; outer verticals present; 4 or 5 post-ocular rows; 3 PSDC; anterior acrosticals absent; 2 notopleurals; scutellars 2-1-0; 2A and 3A with only laterals; 1V and hind tibiae bare; 5S small and weakly indented, Figs. 24, 28; corpus closed over ventrally; vesica well developed, Figs. 25, 27, 29; no juxta; ventral sclerotization forms median process and lateral arms, Fig. 26; very little modification.

The members of this genus are found in and around the Caribbean region: Cuba, Florida, Bahamas, Puerto Rico, Panama, and Jamaica. *S. femoralis* var. *simplex* (Ald.) has been reared from decaying fish (Hall 1932).

The above species are the only ones placed in the genus. Aldrich (1916) has described a variety *simplex* of *S. femoralis*. Other species have been placed here by other authors but the descriptions and figures do not support their placement in this genus.

## SUBTRIBE SARCOPHAGINA

This is the largest of the subtribes of the tribe Sarcophagini. It is characterized by the median process being fused to the juxta and the well-developed lateral filaments. The species run the gamut of nutrition from coprophagous and saprophagous to true parasitism. It consists of two generic groups, the *Sarcophaga* and *Johnsonia* groups. See Charts 3, 4, and 5 for the evolution of the groups, genera and species.

## Johnsonia Group

This group is characterized by the presence of the reduced phallic tube, Fig. 46, or lateral plates, Fig. 44, or a highly membranous phallus, Fig. 36. The vesica is generally lacking. Both notopleurals and PSDC

run from 2 to 4. The capitis is present only in the genus *Helicobia*. The fifth sternite may be small. The group consists of the genera *Camptops*, *Chloronesia*, *Argoravinia*, *Johnsonia*, and *Helicobia*. See Chart 4 for the evolution of its genera and species.

### Genus *Camptops* Aldrich

**Camptops** Aldrich 1916. *Sarcophaga* and Allies, p. 34. Genotype *Camptops unicolor* Ald.

**Harpagopyga** Aldrich 1916. *Sarcophaga* and allies, p. 61. Genotype *Sarcophaga diversipes* Coq.

Frontal rows not divergent below; outer verticals present; oral vibrissae may be above the oral margin; 3 post-ocular rows; anterior acrosticals absent; 3 to 6 hypopleurals; scutellars 3-0-0; 2 notopleurals; 2A with only laterals or a row; 3A with marginal row of bristles; 1V bare or setulose; hind tibiae bare; 4S small, moderately indented, Fig. 35; corpus mostly membranous, Fig. 36; vesica membranous, Figs. 34, 36; juxta, lateral filaments, and fused median process present.

The genitalia of the two genera listed above are very similar, if not almost identical. On the basis of this and the general similarity in chaetotaxy the types are considered to be congeneric.

The species of this genus are New World in distribution. Thompson (1947) lists *H. diversipes* as a parasite of *Laphygma* (Phalaenidae).

### Included Species

<i>angustiventris</i> (Curran & Walley) 1934	No	D (Curran & Walley 1934)
<i>divergens</i> (Curran & Walley) 1934	No	D (Curran & Walley 1934)
<i>diversipes</i> (Coquillett) 1900	No	D (Aldrich 1916)
<i>unicolor</i> Aldrich 1916	No	S

### Genus *Chloronesia* Townsend

**Chloronesia** Townsend 1912a. Proc. U. S. Nat. Mus. 43:360. Genotype *Chloronesia andina* Tns. (♀)

**Notochaeta** Aldrich 1916. *Sarcophaga* and allies, p. 52. Genotype *Notochaeta subpolita* Ald. equals *Sarcophaga fuscianalis* Wulp.

**Micronotochaeta** Townsend 1927. Rev. Mus. Paulista 15:233. Genotype *Micronotochaeta costalis* Tns. teste Lopes 1946b.

**Udamoctis** Enderlein 1928a. Klass. Sarc., p. 25. Genotype *Udamoctis bogatana* End. teste Lopes 1946b.

Frontal row partly divergent in last 2 bristles; facialia ciliated up to more than halfway to antennal bases; 2 or 3 post-ocular rows; outer vertical rarely well differentiated; 2 or 3 PSDC; 2 to 4 notopleurals; anterior acrosticals variable, generally not well differentiated; propleura generally pilose; scutellars absent; prosternum pilose; 2A with laterals; 3A with



MM to a row; hind tibiae bare; 1V bare; 4S as in Fig. 42; phallus largely membranous; fused median process and the lateral filaments present, Fig. 41; distinct vesica not present; trace of phallic tube present.

The genera *Chloronesia* Tns. and *Notochaeta* Ald. have been separated on the basis of the facialia being ciliate more than half way from the vibrissae to the base of the antennae and the arista plumose almost to the apex in *Chloronesia*, these conditions not being present in *Notochaeta*. The author has examined a male *Chloronesia* sent to him by Dr. Dodge and has found that genitallically it is not separable from *Notochaeta*. The characters given above are not considered sufficient for generic distinction.

The genus is almost entirely Mexican and tropical New World in distribution. *C. aldrichi* (Lopes) and *C. confusa* (Lopes) have been reared from *Oligochaeta*, Lopes (1942 & 1946b).

Included Species

<i>aldrichi</i> (Lopes) 1942	No	D (Lopes 1942)
<i>angusta</i> (Aldrich) 1925	No	D (Lopes 1946b)
<i>bogotana</i> (Enderlein) 1928a	No	D (Lopes 1946b)
<i>comata</i> (Aldrich) 1925	No	D (Lopes 1946b)
<i>confusa</i> (Lopes) 1946b	No	D (Lopes 1946b)
<i>costalis</i> (Townsend) 1927	No	D (Lopes 1946b)
<i>cyaniventris</i> (Lopes) 1946b	No	D (Lopes 1946b)
<i>dimidiata</i> (Wiedemann) 1830	No	D (Lopes 1946b)
<i>distincta</i> (Lopes) 1947a	No	D (Lopes 1947a)
<i>diversa</i> (Lopes) 1946b	No	D (Lopes 1946b)
<i>diversinervis</i> (Van der Wulp) 1896	Ne	D (Lopes 1946b)
<i>fumipennis</i> (Lopes) 1946b	No	D (Lopes 1946b)
<i>fuscianalis</i> (Van der Wulp) 1896	Ne, No	D (Lopes 1946b)
<i>ignota</i> (Lopes) 1947a	No	D (Lopes 1947a)
<i>micropyga</i> (Van der Wulp) 1896	Ne	D (Lopes 1946b)
<i>obscura</i> (Lopes) 1950a	No	D (Lopes 1950a)
<i>parva</i> (Lopes) 1946b	No	D (Lopes 1946b)
<i>plumigera</i> (Van der Wulp) 1896	Ne	D (Lopes 1946b)
<i>rustica</i> (Lopes) 1950a	No	D (Lopes 1950a)
<i>sp.</i>	No	S
<i>townsendi</i> (Aldrich) 1925	No	D (Lopes 1946b)
<i>uniseta</i> (Lopes) 1950a	No	D (Lopes 1950a)
<i>viridis</i> (Lopes) 1950a	No	D (Lopes 1950a)

Genus *Argoravinia* Townsend

*Argoravinia* Townsend 1917b. Proc. Biol. Soc. Wash. 30:190. Genotype *Sarcophaga argentea* Tns. equals *Sarcophaga fissa* Ald. equals *Sarcophaga modesta* Wied. teste Ald. 1930.

Frontal row barely divergent; outer verticals present; 2 post-ocular rows; 4 PSDC, 2 small, 2 large; anterior acrosticals not distinct; scutellars 2-1-0; 2A with laterals only; 3A with MM; 1V setulose, hind tibiae bare;

5S with long base and no window, Fig. 37; median process very long and sinuate, Fig. 39; vesica small; lateral filaments Y-shaped; no juxta.

The only species considered here, the type species, is recorded from Panama, the West Indies, and South America. The biology is not known.

Genus **Johnsonia** Coquillet

Frontal row divergent in last 1 to 3 bristles; outer vertical absent; 3 or 4 post-ocular rows; 3 or 4 PSDC; anterior acrosticals poorly differentiated; scutellar bristles variable; 1V bare or setose; 5V bare or setose; hind tibiae bare; 2A with MM present or absent; 3A with or without MM; reduced phallic tube present; lateral filaments and median process fused to juxta present; lateral plates small; vesica present or absent; Figs. 43-51.

Key to Subgenera—Males

- 1. First vein bare; vesica present; posterior dorsocentrals, 4 in number . . . . . **Emblemasoma**  
First vein setulose; vesica absent; posterior dorsocentrals, 3 in number . . . . . **Johnsonia**

Subgenus **Emblemasoma** Aldrich

**Emblemasoma** Aldrich 1916. *Sarcophaga* and allies, p. 56. Genotype *Emblemasoma erro* Ald.

The characters given in the key are sufficient to define the subgenus; see Figs. 45 to 47 for the genitalia.

The species of this subgenus are New World in distribution. The biology is not known.

Included Species

<i>erro</i> (Aldrich) 1916	Ne, No	S
<i>faciale</i> (Aldrich) 1916	Ne	D (Aldrich 1915)

Subgenus **Johnsonia** Coquillet

**Johnsonia** Coquillet 1895. Proc. Acad. Nat. Sci. 47:316. Genotype *Johnsonia elegans* Coq.

**Sthenopyga** Aldrich 1916. *Sarcophaga* and allies, p. 59. Genotype *Sthenopyga globosa* Ald. equals *Sarcophaga rufitibia* Wulp.

5V bare or setose; otherwise key characters will suffice to define the subgenus. See Figs. 43, 44, 48-51.

The members of this subgenus are New World in distribution. Their biology is not known.

Included Species

<i>bivittata</i> Curran 1928	No	D (Curran 1928)
<i>borealis</i> Reinhard 1937	Ne	D (Hallock 1939)
<i>elegans</i> Coquillet 1895	Ne	D (Aldrich 1916)
<i>frontalis</i> Aldrich 1929	Ne	D (Aldrich 1929)
<i>lagunicula</i> Hall 1933a	No	D (Hall 1933a)



<i>rufitibia</i> (Van der Wulp) 1896	Ne	S
<i>setosa</i> Aldrich 1916	No	D (Aldrich 1916)
<i>sp.</i>	Ne	S

Genus *Helicobia* Coquillet

**Helicobia** Coquillet 1895. Proc. Acad. Nat. Sci. Phil. 317. Genotype *Helicobia helici* Tns. equals *Sarcophaga rapax* Walk.

**Helicobiopsis** Townsend 1927. Rev. Mus. Paulista 12:313. Genotype *Helicobiopsis aurescens* Tns. teste Lopes 1938c.

**Notochaetophyto** Hall 1933a. Bull. Amer. Mus. Nat. Hist. 46:258. Genotype *Notochaetophyto resinata* Hall teste Lopes 1938c.

Frontal row barely divergent; outer vertical variable; 3 post-ocular rows; 3 PSDC; anterior acrosticals seldom well developed; scutellars 2-1-1; 2A with laterals only; 3A with MM; IV setulose; hind tibiae bare; 5S with window and moderate base, Figs. 53, 60; vesica absent; lateral plates present (except *H. australis* J. & T.), Figs. 58, 62; juxta depressed, with fused median process; capitis present, Figs. 54, 59; lateral filaments present, Figs. 56, 59.

The members of this genus are New World. The species placed in *Helicobia* Coq. by Curran (1934a) do not, if the published figures can be relied on, belong in *Helicobia* Coq. as constituted here. *H. australis* J. & T. is tentatively included here, but it is believed that it will fall in a separate genus when more of the Australian and Oriental fauna has been critically examined.

*H. rapax* will develop as a scavenger, Hayes (1917), Graenicher (1931), and as a parasite of various insects, Aldrich (1916), Plank (1929), Decker (1931), Breakey (1931), Thompson (1943-47), and others. Fuller (1938) has worked out the biology of *H. australis*. Thompson (1947) records *H. surrubea* as a parasite of *Diatrea*.

Included Species

<i>aurescens</i> (Townsend) 1927	No	D (Lopes 1938c)
<i>australis</i> Johnston & Tiegs 1921	A	S
<i>borgmeeri</i> Lopes 1938c	No	D (Lopes 1938c)
<i>iheringi</i> Lopes 1938c	No	D (Lopes 1938c)
<i>morionella</i> (Aldrich) 1930	Ne, No	S
<i>neglecta</i> Lopes 1946a	Ne	D (Lopes 1946a)
<i>pilifera</i> Lopes 1938c	No	D (Lopes 1938c)
<i>pilipleura</i> Lopes 1938c	No	T (Lopes 1938c)
<i>rapax</i> (Walker) 1849	Ne, No	S
<i>resinata</i> (Hall) 1933a	No	T (Lopes 1938c)
<i>setinervis</i> Lopes 1938c	No	D (Lopes 1938c)
<i>stellata</i> (Van der Wulp) 1896	Ne	S (Lopes 1947b)
<i>surrubea</i> (Van der Wulp) 1896	Ne	D (Lopes 1938c)

Sarcophaga Group

This group is characterized by the lack of a phallic tube and lateral

plates; a vesica is generally present as is the capitis on the fused median process. The fifth sternite is well developed and there are never less than 4 notopleurals (not all equally developed) and 3 PSDC. It consists of the genera *Sarcomyia* n. gen., *Sapromyia* n. gen., *Wohlfahrtiopsis*, *Arachnidomyia*, and *Sarcophaga*. See Chart 5 for the evolution of its genera and species.

#### Genus *Sarcomyia* new genus

Frontal row divergent in last 2 bristles; outer verticals present; 4 post-ocular rows; 4 PSDC; anterior acrosticals weak; scutellars 2-1-0 or 1; 2A with laterals only or weak MM; 3A with MM; 1V and hind tibiae bare; corpus and juxta continuous forming a claw-shaped structure, Fig. 79; vesica bent vertically at its middle, Fig. 79; 5S as in Fig. 81.

Genotype *Sarcophaga scelestus* Hall by present designation.

	Included Species		
<i>scelestus</i> (Hall) 1931b	Ne, No	S	
<i>scelestus adunca</i> (Hall) 1933a	No	D (Hall 1933a)	

#### Genus *Wohlfahrtiopsis* Townsend

*Wohlfahrtiopsis* Townsend 1917a. Proc. Biol. Soc. Wash. 30:45. Genotype *Sarcophaga johnsoni* Ald.

*Scarabaeophaga* Townsend 1918. Ins. Ins. Mens. V:160. Genotype *Sarcophaga utilis* Ald.

*Petrosarcophaga* Townsend 1919. Proc. U. S. Nat. Mus., 56:543. Genotype *Petrosarcophaga arizonica* Tns. equals *Sarcophaga bishoppi* Ald.

Frontal row rapidly divergent below; outer verticals present or absent; post-ocular rows 2 or 3; PSDC 5, generally 3 weak 2 strong; anterior acrosticals absent; scutellars 2-1-1; 2A with laterals only; 3A with MM; 1V bare; hind tibiae bare except a few short hairs in *W. johnsoni* (Ald.); 5S with long base, no window; a few strong bristles on inner edges of sternal arms near base of V; corpus unusually shaped, Figs. 82, 86, 89; vesica large and bizarre; juxta free; capitis long and almost detached; Fig. 87. Yellow mass often surrounds phallus.

The three genotypes listed above are the only species in this genus. They are all North American. *W. utilis* (Ald.) has been reared from *Geotrupes splendens* and *Allorhina nitida*, Aldrich (1916), and *Phyllophaga*, Davis (1919). The biology of the others is not known.

#### Genus *Sapromyia* new genus

Frontal row moderately divergent; outer verticals absent; 2 or 3 post-ocular rows; 5 PSDC, 3 weak 2 strong; anterior acrosticals absent; scutellars 2-1-1; 2A with laterals only; 3A with MM, except *S. cooleyi* (Park.); 1V bare; hind tibiae villous; 5S with long base, no window, brush of



bristles on each arm near base of V, Figs. 91, 95, 101; vesica is 2 ventrally setose lobes, Fig. 97; juxta free; capitis small and membranous, Figs. 92, 98, 102, genitalia, Figs. 90-102.

Genotype: *Sarcophaga bullata* Park. by present designation.

The species of this group are mostly North American. Only *S. polistensis offecta* (Lopes) is recorded from South America. *S. cooleyi* (Park.) has been reported from decaying garbage, particularly fish, Aldrich (1916). Twinn (1934) and Stewart (1934) have reported on a case of auricular myiasis involving *S. cooleyi*. Graenicher (1931) has reared *bullata* from decaying meat and insects and (1935) from human excrement. James (1947) mentions *S. bullata* as being incriminated in intestinal myiasis. The author has reared *S. bullata* (Park.) from garbage. *S. polistensis* has been reared from wasps' nests, Hall (1933b). The biology of the others is not known.

Included Species

<i>bullata</i> (Parker) 1916c	Ne	S
<i>cooleyi</i> (Parker) 1914a	Ne	S
<i>libera</i> (Aldrich) 1916	Ne	D (Aldrich 1916)
<i>polistensis</i> (Hall) 1933b	Ne	S
<i>polistensis offecta</i> (Lopes) 1938b	No	D (Lopes 1938b)

Genus *Arachnidomyia* Townsend

*Arachnidomyia* Townsend 1934a. Rev. Ent. Rio de Janeiro 4:111. Genotype *Sarcophaga davidsoni* Coq.

Frontals divergent in last 2 or 3 bristles; outer verticals present or absent; 3 post-ocular rows; 3-5 PSDC; anterior acrosticals variable; scutellars 2-1-1; 2A with or without MM; 3A with MM; 1V bare; hind tibiae bare; 5S well developed, with window, Fig. 65; juxta broad and short; broadly attached to corpus, Figs. 68, 72; median process forward on juxta, Figs. 69, 70, 73; capitis mostly sclerous; harpes and vesica not well developed; lateral filaments may be expanded distally with slight apical spur, Figs. 68, 74.

This genus ranges from U. S. to Cuba. *A. davidsoni* (Coq.) and *A. subaenescens* (Ald.) have been recorded as spider egg mass parasites, Aldrich (1916 & 1925). *A. houghi* (Ald.) is parasitic on Lepidoptera, Knull (1932), Glendenning (1914). *A. aldrichi* (Park.) has been reared from Lepidoptera, Parker (1916), and Glendenning (1914).

Included Species

<i>aldrichi</i> (Parker) 1916d	Ne	S
<i>davidsoni</i> (Coquillett) 1892	Ne, No	S
<i>hinei</i> (Aldrich) 1916	Ne	S
<i>houghi</i> (Aldrich) 1916	Ne	S
<i>subaenescens</i> (Aldrich) 1925	Ne	D (Aldrich 1925)

Genus *Sarcophaga* Meigen

- Sarcophaga** Meigen 1826. Syst. Bes. V, 14. Genotype *Musca carnaria* Linn. Designation by Westwood 1840.
- Myophora** Robineau-Desvoidy 1830. Ess. Myod. 337. Genotype *Musca carnaria* Linn.
- Pierretia** Robineau-Desvoidy 1863. Hist. Dipt. II 422. Genotype *Pierretia praecox* R. D. designation by Townsend 1917, equals *Sarcophaga nigriventris* Meig.
- Bellieria** Robineau-Desvoidy 1863. Hist. Dipt. II 432. Genotype *Myophora cinerea* R. D. equals *Sarcophaga melanura* Meig. teste Townsend 1938.
- Scaligeria** Robineau-Desvoidy 1863. Hist. Dipt. II 478. Genotype *Myophora maialis* R. D. equals *Myophora cinerea* R. D. teste Townsend 1938.
- Erichsonia** Robineau-Desvoidy 1863 (Preocc.) Hist. Dipt. II 481. equals *Mulsantia* teste Townsend 1938. Genotype *Sarcophaga haemorrhoea* Meig.
- Hartigia** Robineau-Desvoidy 1863. Hist. Dipt. II 521. Genotype *Hartigia concolor* R. D. equals *Sarcophaga dissimilis* Meig. teste Townsend 1938.
- Bercaea** Robineau-Desvoidy 1863. Hist. Dipt. II 549. Genotype *Bercaea haemorrhoidalis* R. D. equals *Musca haemorrhoidalis* Fallén.
- Mulsantia** Robineau-Desvoidy 1863. Hist. Dipt. II 557. Genotype *Mulsantia campestris* R. D. Designation by Coquillett 1910, equals *Sarcophaga haemorrhoea* Meigen, teste Townsend 1938.
- Calypitia** Robineau-Desvoidy 1863. Hist. Dipt. II 576. Genotype *Calypitia carceli* R. D. Designation by Townsend 1916, equals *Myophora cinerea* R. D. teste Townsend 1938.
- Heteronychia** Brauer & Bergenstamm, 1889. Zweifl. Kais. Mus. IV part I; 124. Genotype *Heteronychia chaetonura* B. & B. Congeneric with *Hartigia concolor* R. D. teste Townsend 1938.
- Sarcotachinella** Townsend 1892a. Tr. Am. Ent. Soc. XIX, 110. Genotype *Sarcotachinella intermedia* Tns. equals *Sarcophaga sinuata* Meig.
- Bercaeopsis** Townsend 1917b. Proc. Biol. Soc. Wash. 30:192. Genotype *Sarcophaga tetra* Ald.
- Sarracenomyia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:192. Genotype *Sarcophaga sarraceniae* Riley.
- Parasarcophaga** Johnston & Tiegs 1921. Proc. Roy. Soc. Queensland 23:78. Genotype *Sarcophaga omega* J. & T.
- Robinauella** Enderlein 1928a. Klass. Sarc.:29. Genotype *Sarcophaga scoparia* Pandellé.
- Mehria** Enderlein 1928a. Klass. Sarc.:29. Genotype *Sarcophaga nemoralis* Kramer.



- Discachaeta** Enderlein 1928a. Klass. Sarc.:30. Genotype *Sarcophaga cucullans* Pandellé.
- Arhopocnemis** Enderlein 1928a. Klass. Sarc.:33, equals *Sarcotachinella* Townsend. Genotype *Sarcophaga sinuata* Meigen.
- Athyrsia** Enderlein 1928a. Klass. Sarc.:34, equals *Pierretia* R. D. teste Townsend 1938. Genotype *Sarcophaga nigriventris* Meigen.
- Villeneuveella** Enderlein 1928a. Klass. Sarc.:34. Genotype *Sarcophaga soror*. Rond.
- Helicophagella** Enderlein 1928a. Klass. Sarc.:38. Genotype *Sarcophaga noverca* Rond.
- Ctenodasypygia** Enderlein 1928a. Klass. Sarc.:40. Genotype *Sarcophaga fertoni* Vill.
- Dasypygia** Enderlein 1928a. Klass. Sarc.:40. Genotype *Sarcophaga arvorum* Rond. nec Meig. equals *Sarcophaga depressifrons* Zett.
- Liopygia** Enderlein 1928a. Klass. Sarc.:41. Genotype *Musca ruficornis* Fabr.
- Thyrsocnema** Enderlein 1928a. Klass. Sarc.:42. Genotype *Sarcophaga incisilobata* Pandellé.
- Kramerella** Enderlein 1928a. Klass. Sarc.:48, equals *Hartigia* R. D. teste Townsend 1937. Genotype *Sarcophaga granulata* Kramer.
- Sarina** Enderlein 1928a. Klass. Sarc.:48. Genotype *Sarcophaga nigrans* Pand. equals *Sarcophaga clathrata* Meig.
- Boettcherella** Enderlein 1928a. Klass. Sarc.:49. Genotype *Sarcophaga setinervis* Rond.
- Athyrsomima** Rohdendorf 1937. Faune d'U.R.S.S.:185. Genotype *Athyrsomima stackelbergi* Rohdendorf.
- Pandelleana** Rohdendorf 1937. Faune d'U.R.S.S.:189. Genotype *Sarcophaga protuberans* Pandellé.
- Stackelbergeola** Rohdendorf 1937. Faune d'U.R.S.S.:257. Genotype *Sarcophaga mehadiensis* Böttcher.
- Phallocheira** Rohdendorf 1937. Faune d'U.R.S.S.:267. Genotype *Phallocheira minor* Rohdendorf.
- Boettcherisca** Rohdendorf 1937. Faune d'U.R.S.S.:270. Genotype *Sarcophaga peregrina* R. D.
- Kramerea** Rohdendorf 1937. Faune d'U.R.S.S.:274. Genotype *Sarcophaga schutzei* Kram.
- Harpagophalla** Rohdendorf 1937. Faune d'U.R.S.S.:276. Genotype *Sarcophaga sera* Rohdendorf.
- Hoa** Rohdendorf 1937. Faune d'U.R.S.S.:291. Genotype *Sarcophaga flexuosa* Ho.
- Coprosarcophaga** Rohdendorf 1937. Faune d'U.R.S.S.:293. Genotype *Sarcophaga haemorrhoidalis* Fall.

**Phytosarcophaga** Rohdendorf 1937. Faune d'U.R.S.S.:301. Genotype *Sarcophaga destructor* Malloch.

**Tricholioproctia** Baranoff 1938. Bull. Ent. Res. 29:414. Genotype *Sarcophaga antilope* Bött.

**Probellieria** Blanchard 1942. Physis, 19:149. Genotype *Sarcophaga barbata* Thoms. equals *Sarcophaga argyrostoma* R. D.

This genus as considered here is the largest and most widespread of all sarcophagine genera. It has been divided into many small genera by various authors in different parts of the world, hence the rather ponderous synonymy above. It is felt, that, for the present, the relationship of the species included is best expressed by considering *Sarcophaga*, in the sense used here, as a single large genus. The genera proposed by Rohdendorf (1937) if lowered to subgeneric rank are the best subdivisions of this genus as yet proposed. A study of the entire world fauna will be necessary to solve the problem fully. Most of the new species described by Rohdendorf (1937), from page 129 on, will fall in *Sarcophaga* as considered here. The genus *Stephanostoma* Lenz, as proposed by Townsend (1938), is not accepted here.

Frontal row divergent in last 2-5 bristles; ocellars well developed; 3 or 4 post-ocular rows; outer verticals present or absent; 3-6 PSDC; if more than 4, not equal in thickness; scutellars 2 or 3-1-1; apical may be absent; 3-12 hypopleurals; 2A occasionally with MM; 3A with MM to a complete row; hind tibiae generally villous; 1V bare; 5S, Figs. 116, 142, 200, large and well developed; vesica, juxta, median process fused to juxta and lateral filaments, Figs. 102, 133, 160, present; harpes and capitiss generally present; phallopore and phallus always separate. Genitalia in Figs. 33-214.

The distribution is almost world-wide. *Sarcophaga* is found in all regions but is very poorly represented in the neotropical. Its presence in the oceanic islands in the Pacific is undoubtedly due to introduction.

The genus *Sarcophaga* is very large and its food habits run the gamut from saprophagous and coprophagous nutrition to human parasitism. This is often true of a single species such as *S. haemorrhoidalis*. It has been reared from dung, Aldrich (1916), Knipling (1936); has been reported as a parasite of insects, Hinds & Dew (1915), Regnier (1931), Webster (1907); and has been incriminated in cases of human intestinal myiasis, Aldrich (1916), Haseman (1917). *S. sarraceniae* has been reared from *Sarracenia*, Aldrich (1916); and Thompson (1943) recorded it as a parasite of *Allorhina nitida*. Members of this genus have been recorded as reared from dead insects, Jack (1935), decaying snails, decaying vegetable matter, dead toads and snakes, dead mammals, and parasitic on a lumbricid worm, Senior-White (1940). Séguy (1929) lists *S. melanura* reared from a swallow.



## Included Species

<i>acadiana</i> Reinhard 1947	Ne	D (Reinhard 1947)
<i>aegyptica</i> Salem 1935	P	D (Salem 1935)
<i>albiceps</i> Meigen 1826	P,O,A	D (Séguy 1941b)
<i>alpha</i> Johnston & Tiegs 1921	A	D (Johnston & Hardy 1923)
<i>amita</i> Rondani 1861b	P	D (Séguy 1941b)
<i>ancilla</i> Rondani 1865	P	T (Séguy 1941b)
<i>ancilloides</i> Baranoff 1927	P	T (Baranoff 1927)
<i>antilope</i> Böttcher 1913c	O	D (S.-White et al. 1940)
<i>aratrix</i> Pandellé 1896	P	S
<i>arcipes</i> Pandellé 1896	P	S
<i>argyrostoma</i> Robineau-Desvoidy 1830	Ne,No,P,O, E,Oc	S
<i>aurifrons</i> Macquart 1846	A	D (Johnston & Hardy 1923)
<i>ballardi</i> Senior-White 1924	O	T (S.-White et al. 1940)
<i>balmstadi</i> Curran 1934a	E	T (Curran 1934a)
<i>bancrofti</i> Johnston & Tiegs 1921	A	T (Johnston & Hardy 1923)
<i>banksi</i> Senior-White 1924	O	T (S.-White et al. 1940)
<i>basalis</i> Walker 1859	O	T (S.-White et al. 1940)
<i>beesoni</i> Senior-White 1924	O	T (S.-White et al. 1940)
<i>benaci</i> Böttcher 1913a	P	T (Séguy 1941b)
<i>beta</i> Johnston & Tiegs 1921	A	D (Johnston & Hardy 1923)
<i>bezziana</i> Böttcher 1913a	P	T (Séguy 1941b)
<i>bolivari</i> Gil Collado 1930	P	T (Séguy 1941b)
<i>böttcheriana</i> Rohdendorf 1937	P	D (Séguy 1941b)
<i>brevicornis</i> Ho 1934b	O	D (S.-White et al. 1940)
<i>burungae</i> Curran 1934a	E	T (Curran 1934a)
<i>carnaria</i> (Linnaeus) 1758	No,P	S
<i>caudegalli</i> Böttcher 1912c	O	T (S.-White et al. 1940)
<i>cessator</i> Aldrich 1916	Ne	T (Aldrich 1916)
<i>chaetonura</i> (Brauer & Bergenstamm) 1889	P	T (Séguy 1941b)
<i>clathrata</i> Meigen 1826	P	T (Séguy 1941b)
<i>cockerellae</i> Aldrich 1916	Ne	T (Aldrich 1916)
<i>concreata</i> Séguy 1935	O	D (Séguy 1941b)
<i>consanguinea</i> Rondani 1861b	P	D (Séguy 1941b)
<i>corsicana</i> Villeneuve 1911b	P	D (Séguy 1941b)
<i>crassipalpis</i> Macquart 1838	Ne,No,P,O,Oc	S
<i>cucullans</i> Pandellé 1896	P	S
<i>cultellata</i> Pandellé 1896	P	T (Séguy 1941b)
<i>czernyi</i> Böttcher 1912d	P	T (Séguy 1941b)
<i>demeilloni</i> Zumpt 1950b	E	T (Zumpt 1950b)
<i>depressa</i> Robineau-Desvoidy 1830	A	D (Johnston & Hardy 1923)
<i>depressifrons</i> Zetterstedt 1845	P	D (Séguy 1941b)
<i>desertorum</i> Salem 1935	P	T (Salem 1935)
<i>destructor</i> Malloch 1929	P,E	T (Salem 1935)
<i>discifera</i> Pandellé 1896	P	D (Séguy 1941b)
<i>dissimilis</i> Meigen 1826	P	T (Séguy 1941b)
<i>dolescalli</i> Johnston & Tiegs 1921	A	D (S.-White et al. 1940)
<i>dura</i> Curran 1934a	E	D (Curran 1934a)
<i>elongata</i> Aldrich 1916	Ne	D (Aldrich 1916)
<i>epsilon</i> Johnston & Tiegs 1922b	A	D (Johnston & Hardy 1923)

<i>eta</i> Johnston & Tiegs 1921	A	D (Johnston & Hardy 1923)
<i>exuberans</i> Pandellé 1896	Ne,P	S
<i>falciforceps</i> Villeneuve 1929	E	T (Curran 1934a)
<i>ferox</i> Villeneuve 1908	P	T (Séguy 1941b)
<i>fertoni</i> Villeneuve 1911b	P	T (Séguy 1941b)
<i>flexuosa</i> Ho 1934a	P	T (Rohdendorf 1937)
<i>fortisa</i> Reinhard 1947	Ne	T (Reinhard 1947)
<i>frogatti</i> Taylor 1917	A	T (Johnston & Hardy 1923)
<i>fulvipes</i> Macquart 1842	Ne,No	S
<i>garbo</i> Curran 1934a	E	D (Curran 1934a)
<i>gnu</i> Curran 1934a	E	T (Curran 1934a)
<i>gracilis</i> Aldrich 1916	Ne	S
<i>granulata</i> Kramer 1908a	P	D (Séguy 1941b)
<i>guillermodi</i> Zumpt 1950a	E	D (Zumpt 1950a)
<i>haemorrhoea</i> Meigen 1826	P	S
<i>haemorrhoidalis</i> Fallén 1818	Ne,P,O,E,Oc	S
<i>haemorrhoides</i> Böttcher 1913a	P	D (Séguy 1941b)
<i>hardyi</i> Johnston & Tiegs 1922b	A	T (Johnston & Hardy 1923)
<i>harpax</i> Pandellé 1896	Ne,P,O,E,Oc	S
<i>henryi</i> Senior-White 1924	O	D (S.-White et al. 1940)
<i>hirticrus</i> Pandellé 1896	P	T (Séguy 1941b)
<i>hirtipes</i> Wiedemann 1830	Ne,P,O,E	D (Séguy 1941b)
<i>hollandia</i> Roback 1952	A	S
<i>hui</i> Ho 1936	O	D (S.-White et al. 1940)
<i>idmais</i> Séguy 1934	O	D (S.-White et al. 1940)
<i>idonea</i> Aldrich 1916	Ne	S
<i>imitatrix</i> Baranoff 1938	A	D (Baranoff 1938)
<i>incisilobata</i> Pandellé 1896	P	S
<i>infixa</i> Böttcher 1913a	P	T (Séguy 1941b)
<i>inzi</i> Curran 1934a	E	D (Curran 1934a)
<i>impatiens</i> Walker 1849	A	T (Hardy 1943)
<i>josephi</i> Böttcher 1912c	O	T (S.-White et al. 1940)
<i>juliaetta</i> Aldrich 1916	Ne	S
<i>kappa</i> Johnston & Tiegs 1921	A	D (Johnston & Hardy 1923)
<i>kawayuensis</i> Kano 1950	P	D (Kano 1950)
<i>kentejana</i> (Rohdendorf) 1937	P	D (Rohdendorf 1937)
<i>kentejana lapponica</i> Tiensuu 1939	P	D (Tiensuu 1939)
<i>kerteszi</i> Villeneuve 1912c	P	T (Séguy 1941b)
<i>khasiensis</i> Senior-White 1924	O	T (S.-White et al. 1940)
<i>kohla</i> Johnston & Tiegs 1921	A	C (Johnston & Hardy 1923)
<i>littoralis</i> Johnston & Tiegs 1922b	A	T (Johnston & Hardy 1923)
<i>longicornis</i> Macquart 1843	P	T (Séguy 1941b)
<i>lunigera</i> Böttcher 1914	P	T (Séguy 1941b)
<i>maculata</i> Meigen 1838	P	D (Séguy 1941b)
<i>marshalli</i> Parker 1923	P	D (Séguy 1941b)
<i>mehadiensis</i> Böttcher 1912b	P	D (Séguy 1941b)
<i>melanura</i> Meigen 1826	Ne,P,O	S
<i>mendax</i> Reinhard 1947	Ne	D (Reinhard 1947)
<i>mimoris</i> Reinhard 1947	Ne	T (Reinhard 1947)
<i>minor</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>minutissima</i> Hall 1929b	Ne	D (Hall 1929b)



<i>misera</i> Walker 1849	P,O,A	S
<i>montanensis</i> Hallock 1938	Ne	D (Hallock 1940)
<i>mulaba</i> Curran 1934a	E	T (Curran 1934a)
<i>musitali</i> Curran 1934a	E	D (Curran 1934a)
<i>musprattianus</i> Zumpt 1951	E	T (Zumpt 1951)
<i>natalensis</i> Zumpt 1951	E	D (Zumpt 1951)
<i>nemoralis</i> Kramer 1908a	P	D (Séguy 1941b)
<i>nigriventris</i> Meigen 1826	P,O	S
<i>noverca</i> Rondani 1861b	P	T (Séguy 1941b)
<i>occidentalis</i> Aldrich 1916	Ne	S
<i>offuscata</i> Schiner 1862	P	S
<i>omega</i> Johnston & Tiegs 1921	A	D (Johnston & Hardy 1923)
<i>omikron</i> Johnston & Tiegs 1921	A	D (Johnston & Hardy 1923)
<i>orchidea</i> Böttcher 1913c	P,O,A	D (S.-White et al. 1940)
<i>ostindicae</i> Senior-White	O	T (S.-White et al. 1940)
<i>parallela</i> Aldrich 1916	Ne	S
<i>pattoni</i> Senior-White 1924	O	T (S.-White et al. 1940)
<i>pandellei</i> Rohdendorf 1937	P	D (Séguy 1941b)
<i>pauciseta</i> Pandellé 1896	P	T (Séguy 1941b)
<i>penicillata</i> Villeneuve 1907	P	D (Séguy 1941b)
<i>peregrina</i> Robineau-Desvoidy 1830	O,A,Oc	D (Séguy 1941b)
<i>perspicax</i> Aldrich 1916	Ne	D (Aldrich 1916)
<i>piva</i> Roback 1952	A	S
<i>preussi</i> Zumpt 1951	E	T (Zumpt 1951)
<i>privigna</i> Rondani 1861b	P	S
<i>procax</i> Séguy 1932	P	T (Séguy 1941b)
<i>prosbalina</i> Baranoff 1931	O	T (S.-White et al. 1940)
<i>protuberans</i> Pandellé 1896	P	S
<i>proxima</i> Rondani 1861b	P	T (Séguy 1941b)
<i>pseudoscoparia</i> Kramer 1911	P	D (Séguy 1941b)
<i>pulla</i> Aldrich 1916	Ne	S
<i>pumila</i> Meigen 1826	P	S
<i>pusana</i> Senior-White 1924	O	T (S.-White et al. 1940)
<i>rostrata</i> Pandellé 1896	P	D (Séguy 1941b)
<i>ruficornis</i> (Fabricius) 1794	No,O,E	D (Lopes 1945c)
<i>santos-diasi</i> Zumpt 1951	E	T (Zumpt 1951)
<i>sarraceniae</i> Riley 1873	Ne	S
<i>sarracenioides</i> Aldrich 1916	Ne	S
<i>schineri</i> Bezzi 1891	P	D (Séguy 1941b)
<i>schnabli</i> Villeneuve 1911b	P	T (Séguy 1941b)
<i>schutzei</i> Kramer 1909	P	T (Séguy 1941b)
<i>scoparia</i> Pandellé 1896	P,O	D (Séguy 1941b)
<i>scoparia nearctica</i> Parker 1916c	Ne	S
<i>scopariformis</i> Senior-White 1927	O	D (S.-White et al. 1940)
<i>semimarginalis</i> Hall 1931	Ne	T (Hall 1931)
<i>sera</i> Rohdendorf 1930	O	D (S.-White et al. 1940)
<i>serbica</i> Baranoff 1930	P	T (Séguy 1941b)
<i>setinervis</i> Rondani 1861b	P	T (Séguy 1941b)
<i>setipennis</i> Rondani 1861b	P	T (Séguy 1941b)
<i>setosa</i> Baranoff 1929	P	D (Séguy 1941b)

<i>sima</i> Aldrich 1916	Ne	S
<i>similis</i> Meade 1876	P,O	D (Séguy 1941b)
<i>sinuata</i> Meigen 1828	Ne,P	S
<i>soror</i> Rondani 1861b	P	S
<i>spinosa</i> Villeneuve 1912b	P	D (Séguy 1941b)
<i>stackelbergi</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>strenua</i> Robineau-Desvoidy 1863	P	T (Séguy 1941b)
<i>subdiscalis</i> Aldrich 1916	Ne	D (Aldrich 1916)
<i>subdistinguendis</i> Zumpt 1950b	E	T (Zumpt 1950b)
<i>subulata</i> Pandellé 1896	P	T (Séguy 1941b)
<i>subvicina</i> Rohdendorf 1937	P	T (Séguy 1941b)
<i>surcoufi</i> Villeneuve 1912a	P	T (Séguy 1941b)
<i>synia</i> Johnston & Hardy 1923	A	D (Johnston & Hardy 1923)
<i>talonata</i> Senior-White 1925	O	D (S.-White et al. 1940)
<i>tarsata</i> Aldrich 1916	Ne	S
<i>teretirostris</i> Pandellé 1896	P	D (Séguy 1941b)
<i>tetra</i> Aldrich 1916	Ne	S
<i>thalthammeri</i> Böttcher 1913a	P	T (Séguy 1941b)
<i>thatuna</i> Aldrich 1916	Ne	S
<i>tibialis</i> Macquart 1850	P,E	D (Séguy 1941b)
<i>traansvalensis</i> Zumpt 1950a	E	D (Zumpt 1950a)
<i>tryoni</i> Johnston & Tiegs 1921	A	T (Johnston & Hardy 1923)
<i>tsushimae</i> Senior-White 1924	P	D (S.-White et al. 1940)
<i>uamensis</i> Zumpt 1951	E	T (Zumpt 1951)
<i>uliginosa</i> Kramer 1908a	Ne,P	D (Séguy 1941b)
<i>vagans</i> Meigen 1826	P	S
<i>vansoni</i> Zumpt 1950b	E	T (Zumpt 1950b)
<i>vicina</i> Macquart 1835	P	T (Séguy 1941b)
<i>villa</i> Curran 1934a	E	D (Curran 1934a)
<i>villeneuveana</i> Enderlein 1928a	P	T (Séguy 1941b)
<i>villeneuvei</i> Böttcher 1912c	P	D (Séguy 1941b)
<i>walayari</i> Senior-White 1924	O	D (S.-White et al. 1940)
<i>zeta</i> Johnston & Tiegs 1921	A	D (Johnston & Hardy 1923)
<i>zuluensis</i> Zumpt 1950b	E	D (Zumpt 1950b)

## SUBTRIBE RAVINIINA

This group of three genera is almost exclusively New World in distribution. It represents a line of development in which the primitive ventral sclerotization has given rise to a free median process and lateral arms. This triad and its modifications have moved upward into the corpus and do not project. The phallophore and phallus are fused and the corpus is partly or completely closed over ventrally. See Chart 6 for the evolution of the genera and species and Chart 3 for its relationship to the other subtribes and Chart 6 for the evolution of its genera and species.

Genus *Ravinia* Robineau-Desvoidy

*Ravinia* Robineau-Desvoidy 1863. Hist. Dipt. II 434. Genotype *Sarcophaga haematodes* Meig. equals *Musca striata* Fabr.



- Punasarcophaga** Townsend 1915c. Proc. U. S. Nat. Mus. 49:408. Genotype *Punasarcophaga auromaculata* Tns.
- Andinoravinia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:120. Genotype *Andinoravinia rufipes* Tns.
- Chaetoravinia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:190. Genotype *Helicobia quadrisetosa* Coq. equals *Sarcophaga stimulans* Walk.
- Euravinia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:191. Genotype *Myophora l'herminieri* H. D.
- Miltoravinia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:191. Genotype *Sarcophaga planifrons*. Ald.
- Trixosarcophaga** Townsend 1917b. Proc. Biol. Soc. Wash. 30:191. Genotype *Sarcophaga aurigena* Tns. ( ♀ )
- Catasarcophaga** Townsend 1927. Rev. Mus. Paulista 15:220. Genotype *Catasarcophaga trivittata* Tns. ( ♀ ) teste Lopes 1941.
- Engelina** Enderlein 1928a. Klass. Sarc.:16. Genotype *Sarcophaga xanthopyga* End. nec. Wulp equals *Andinoravinia rufipes* Tns. teste Townsend 1938.

Frontal bristles generally parallel or but slightly divergent; divergent in last 2 bristles in some species; outer verticals variable; 2 post-ocular rows; 3 or 4 PSDC; anterior acrosticals well developed; 6 to 11 hypopleurals; scutellars 2 or 3-1-0; 2A with only laterals; 3A with MM; 5S deeply incised; brush of short bristles along inner margin of sternal arms, Figs. 234, 235; no sternal window; 1V setulose or bare; hind tibiae bare; phallopore and phallus fused, Figs. 220, 233; hillae, Figs. 217, 233, present; juxta present only in *Ravinia effrenata* (Walk.), Fig. 229; median process short; lateral arms not retained; dorsal rods Figs. 216, 222, present; vesica simple; no lateral filaments.

The distribution of this genus is Nearctic and Neotropical. Of the twenty species discussed by Hall (1927), twelve are Nearctic, five are Neotropical and three are from Central America and the West Indies. *Ravinia striata* (Fabr.) is Palearctic and Oriental.

Most of the members of this genus, whose biology is known, are coprophagous. This includes *R. pusiola*, *R. l'hermineri*, *R. sueta*, *R. stimulans*, *R. latisetosa*, *R. laakei*, *R. avida*. Séguy (1932a) records *R. striata* as a grasshopper parasite and Thompson (1943) lists it from *Oryctes nasicornis*. Van Emden (1950) records *R. errabunda* from *Epilachna* and a questionable record of *R. l'herminieri* from *Lachnosterna*. Knipling (1936) has reared some of the species of this genus on meat in the laboratory. James (1947) records a doubtful record of *R. striata* causing gastro-intestinal myiasis. It has also been recorded in cases of wound myiasis.

Included Species

<i>addentata</i> (Hall) 1929a	Ne	D (Hall 1928)
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<i>almeidai</i> (Lopes) 1946c	No	D (Lopes 1946c)
<i>assidua</i> (Walker) 1852	Ne	D (Aldrich 1930)
<i>aureopyga</i> (Hall) 1928	Ne	D (Hall 1928)
<i>auromaculata</i> (Townsend) 1915c	No	D (Hall 1928)
<i>aurigena</i> (Townsend) 1912a	No	S
<i>belforti</i> Prado & Fonseca 1932	No	D (Prado & Fonseca 1932)
<i>coachellensis</i> (Hall) 1931a	Ne	D (Hall 1931a)
<i>dampfi</i> (Lopes) 1946a	Ne	D (Lopes 1946a)
<i>duplicata</i> (Hall) 1928	Ne	D (Hall 1928)
<i>effrenata</i> (Walker) 1860	Ne, No	S
<i>errabunda</i> (Van der Wulp) 1896	Ne	S
<i>floridensis</i> (Aldrich) 1916	Ne	S
<i>globulus</i> (Aldrich) 1916	No	D (Hall 1928)
<i>laakei</i> (Hall) 1931a	Ne	S
<i>latisetosa</i> Parker 1914b	Ne	S
<i>lherminieri</i> (Robineau-Desvoidy) 1830	Ne	S
<i>meinckei</i> (Blanchard) 1939	No	D (Blanchard 1939)
<i>obscuripes</i> (Hall) 1928	Ne	D (Hall 1928)
<i>ollantaytambensis</i> (Hall) 1928	No	D (Hall 1928)
<i>pectinata</i> (Aldrich) 1916	Ne	S
<i>planifrons</i> (Aldrich) 1916	Ne	S
<i>pusiola</i> (Van der Wulp) 1896	Ne	S
<i>querula</i> (Walker) 1837	Ne	S
<i>rufipes</i> (Townsend) 1917b	No	D (Hall 1928)
<i>stimulans</i> (Walker) 1849	Ne	S
<i>striata</i> (Fabricius) 1794	P, O	D (Séguy 1941b)
<i>sueta</i> (Van der Wulp) 1896	Ne	S
<i>tancituro</i> Roback 1952	No	S
<i>trivittata</i> (Townsend) 1927	No	D
<i>vagabunda</i> (Van der Wulp) 1895	Ne	D (Lopes 1946a)

#### Genus *Oxysarcodexia* Townsend

***Oxysarcodexia*** Townsend 1917b. Proc. Biol. Soc. Wash. 30:191, 194, 195. Genotype *Sarcophaga peltata* Ald.

***Dasyproctia*** Enderlein 1928a. Klass. Sarc.:23. Genotype *Sarcophaga praevolans* End. nec. Wulp equals *Sarcophaga ochripyga* Wulp teste Tns.

Frontal bristles only slightly divergent; outer verticals absent; three post-ocular rows; 3-5 PSDC; if 4 or 5 not all equally developed; 6 to 12 hypopleurals; scutellars 2 or 3-1-0; a weak pair of apicals sometimes present; 2A with only laterals; 3A with MM, lacking in *O. peltata* (Ald.); 5S deeply incised; brush on sternal arms poorly developed, Figs. 263, 265; no sternal windows; 1V bare; hind tibiae generally bare; phallophore and phallus fused, Fig. 280; lobi and juxta not present; vesica greatly developed, Figs. 262, 264; lateral arms and thin lateral filaments developed, Figs. 260, 270; dorsal rods present. Genitalia, Figs. 256-280.

Like *Ravinia*, the distribution of *Oxysarcodexia* is essentially New



World. Of the 49 species considered by Lopes (1946) 22 are exclusively South American, and four are North American. The remainder are distributed through various combinations of South America, North America, Central America, and the West Indies. Only *O. taitensis* Schiner has been recorded from some Pacific Islands (Galapagos, Tahiti, Samoa, etc.). It is the dominant genus in southern Brazil.

Not much is known regarding the food habits of the members of this genus. Aldrich (1916) and Wilson (1932) have recorded *O. ventricosa* (Wulp) from cow and horse manure and straw. Luginbill (1928) has recorded it as a parasite of *Laphygma frugiperda*. Both it and *O. galeata* Ald. have been reared from excrement.

## Included Species

<i>admixa</i> Lopes 1933	No	D (Lopes 1933)
<i>afficta</i> (Van der Wulp) 1896	Ne,No	D (Lopes 1946b)
<i>amarali</i> Prado & Fonseca 1932	No	D (Prado & Fonseca 1932)
<i>amorosa</i> (Schiner) 1868	No	D (Lopes 1946d)
<i>angolensis</i> Hall 1937a	No	D (Hall 1937a)
<i>angrensis</i> Lopes 1933	No	D (Lopes 1946d)
<i>augusta</i> Lopes 1946d	No	D (Lopes 1946d)
<i>auriceps</i> (Macquart) 1854	No	D (Lopes 1946d)
<i>aurifinis</i> (Walker) 1852	No	D (Lopes 1946d)
<i>avuncula</i> Lopes 1933	No	D (Lopes 1946d)
<i>bakeri</i> (Aldrich) 1916	Ne,No	S
<i>bicolor</i> Lopes 1946d	No	D (Lopes 1946d)
<i>carvalhoi</i> Lopes 1946d	No	D (Lopes 1946d)
<i>cingarus</i> (Aldrich) 1916	Ne	S
<i>comparilis</i> (Reinhard) 1939	Ne	D (Reinhard 1939)
<i>confusa</i> Lopes 1946a	No	D (Lopes 1946d)
<i>culminata</i> (Aldrich) 1926	Ne,No	D (Lopes 1946d)
<i>cyaniforceps</i> (Hall) 1933a	No	D (Lopes 1946d)
<i>diana</i> Lopes 1933	No	D (Lopes 1946d)
<i>edwardsi</i> Lopes 1946d	No	D (Lopes 1946d)
<i>flavifrons</i> (Macquart) 1846	No	D (Lopes 1946d)
<i>fluminensis</i> Lopes 1946d	No	D (Lopes 1946d)
<i>fringidea</i> (Curran & Walley) 1934	No	D (Lopes 1946d)
<i>galeata</i> (Aldrich) 1916	Ne	S
<i>grandis</i> Lopes 1946d	No	D (Lopes 1946d)
<i>illata</i> Lopes 1938b	No	D (Lopes 1938b)
<i>insolita</i> Lopes 1946d	No	D (Lopes 1946d)
<i>intona</i> (Curran & Walley) 1934	No	D (Lopes 1946d)
<i>major</i> Lopes 1946d	No	D (Lopes 1946d)
<i>megista</i> (Hall) 1933a	No	D (Lopes 1946d)
<i>meridionalis</i> (Engel) 1931	No	D (Lopes 1946d)
<i>modesta</i> Lopes 1946d	No	D (Lopes 1946d)
<i>molitor</i> (Curran & Walley) 1934	No	D (Lopes 1946d)
<i>occulta</i> Lopes 1946d	No	D (Lopes 1946d)
<i>ochripyga</i> (Van der Wulp) 1896	Ne,No	S
<i>omissa</i> Lopes 1946a	Ne	D (Lopes 1946a)

<i>parva</i> Lopes 1946d	No	D (Lopes 1946d)
<i>peltata</i> (Aldrich) 1916	Ne, No	S
<i>perнета</i> (Walker) 1860	Ne	D (Lopes 1946d)
<i>plaumanni</i> Lopes 1946d	No	D (Lopes 1946d)
<i>plebeja</i> Lopes 1946a	No	D (Lopes 1946d)
<i>ramosa</i> (Reinhard) 1939	No	D (Reinhard 1939)
<i>riograndensis</i> Lopes 1946d	No	D (Lopes 1946d)
<i>sanguisuga</i> (Hall) 1933a	No	D (Lopes 1946d)
<i>simplicoides</i> Lopes 1933	No	D (Lopes 1946d)
<i>taitensis</i> (Schiner) 1868	A, Oc	D (Lopes 1946d)
<i>timida</i> Aldrich 1916	Ne, No	D (Aldrich 1916)
<i>titubata</i> Lopes 1946c	No	D (Lopes 1946c)
<i>titubata fraterna</i> Lopes 1946a	Ne	D (Lopes 1946a)
<i>trivialis</i> (Van der Wulp) 1896	Ne	S
<i>ventricosa</i> (Van der Wulp) 1896	Ne, No	S
<i>vesica</i> (Hall) 1933a	No	D (Lopes 1946d)
<i>xanthosoma</i> (Aldrich) 1916	Ne, No	S

#### Genus *Cistudinomyia* Townsend

*Cistudinomyia* Townsend 1917a. Proc. Biol. Soc. Wash. 30:48. Genotype *Sarcophaga cistudinis* Ald.

Frontal bristles barely divergent; outer verticals hardly distinct; 3 post-ocular rows; 4-5 PSDC; anterior acrosticals hardly differentiated; scutellars 3 or 4-1-0; 2A with only laterals; 3A with marginal rows of 20; 1V bare; hind tibiae bare; 5S broad with shallow V, Fig. 287; phallopore and phallus fused; vesica claw-shaped in profile, Fig. 286; median process and lateral arms present, Fig. 285; no juxta, filaments, or dorsal rods.

The only species, the genotype above, is recorded only from the United States. Aldrich (1916) records it from New Jersey and the author has seen specimens from Texas.

Aldrich (1916) records *C. cistudinis* as being bred from sores in the side of a box turtle. Knipling (1937) has worked out the biology and immature stages.

#### SUBTRIBE HYSTRICOCNEMINA

Like *Imparia* Roback and *Hypopelta* Ald. the genus *Hystricocnema* is unique. The corpus is long and expanded laterally toward its apex, Figs. 281, 283; it possesses a median process and lateral filaments. The lateral filaments, Fig. 284, resemble those of *Sarcophaga fulvipes* Macq., Fig. 192. The nature of the fifth sternite and the phallus indicate a separate origin from the early sarcophagine-raviniine stock and this genus is given subtribal rank here. See Chart 3.

#### Genus *Hystricocnema* Townsend

*Hystricocnema* Townsend 1919. Ins. Ins. Mens. VI:160. Genotype *Sarcophaga robusta* Ald. equals *Sarcophaga plinthopyga* Wied.

Frontal row slightly divergent in last 2 bristles; outer verticals absent;



2 post-ocular rows; generally 5 PSDC; anterior 2 small, the remaining 3 larger; anterior acrosticals barely differentiated; scutellars 2-1-1; 2A and 3A with only laterals; 1V and hind tibiae bare; a few long hairs sometimes present; 5S as in Fig. 282; anal forceps vertically bipronged, basal part extended vertically; phallus as in Figs. 281, 283.

The genotype is the only species in the genus. *Sarcophaga khalili* Salem 1935 is a synonym of *S. robusta* (Ald.) according to Salem (1936). *H. plinthopyga* is found in southern and western United States, Central and South America, Galapagos, and Hawaii. It has been reared from carrion, Aldrich (1916). Thompson (1943) lists it from *Lachnosterna*. James (1947) cites cases of it as a myiasis producer in man and animals.

### Series 3

In this series, the ventral sclerotization undergoes modification without division (Sarcodexiina and Servaisiina) or divides after it has undergone modification (Boettcheriina). Of those species in this series whose biology is known, most are true parasites. There are no species with two notopleurals or proclinate fronto-orbitals in the male.

This series contains three subtribes. These are Sarcodexiina, Boettcheriina, and Servaisiina. See Chart 3 for the relationships of these subtribes.

#### SUBTRIBE SARCODEXIINA

This subtribe consists of three genera which are held together by possessing median filaments. The vesica is present or absent and a juxta is present only in *Sarcodexia* Tns. All the members of this subtribe are New World in distribution, being found in South America, Central America and the West Indies, and southern United States. Very little is known concerning the biology of most of the species.

See Chart 3 for the relationship of this subtribe to the others, and Chart 7 for the evolution of its genera and species.

#### Genus *Paraphrissopoda* Townsend

**Paraphrissopoda** Townsend 1915b. Ins. Ins. Mens. 3:118. Genotype *Peckia lamanensis* R.-D. equals *Musca gulo* Fab.

**Chrysostomyia** Townsend 1931b. Rev. Ent. Rio de Janeiro. 1:315. Genotype *Sarcophaga chrysostoma* Wied.

Frontal row divergent in last 2 or 3 bristles; outer verticals absent; 3 post-ocular rows; PSDC 5 or 6; 3 or 4 small and 2 large; anterior acrosticals lacking; 8 to 11 hypopleurals; scutellars 2 or 3-0-1; 2A with only laterals; 3A with or without MM; 1V bare; hind tibiae villous; 5S as in Figs. 288, 295, 296; median filaments present; harpes present in some, Figs. 290, 294; vesica present; juxta absent; anal forceps often long and

slightly sinuate in profile; genitalia, Figs. 288-301; see Chart 7 for relationships and evolution.

All the known species in this genus occur in the New World, being found in the southern United States, Panama, West Indies, and South America.

Very little is known of their biology. Lopes (1943) has reared *P. chrysostoma* on meat in the laboratory. James (1947) cites it as a myiasis producer.

Included Species		
<i>amoena</i> (Aldrich) 1916	No	S
<i>bergi</i> (Blanchard) 1939	No	D (Blanchard 1939)
<i>capitata</i> (Aldrich) 1916	No	S
<i>chrysostoma</i> (Wiedemann) 1830	No	S
<i>chrysostomata</i> (Hall) 1933a	No	T (Hall 1933a)
<i>concinata</i> (Williston) 1896	No	D (Aldrich 1916)
<i>enderleini</i> (Engel) 1931	No	T (Engel 1931)
<i>gulo</i> (Fabricius) 1805	No	S
<i>hillifera</i> (Aldrich) 1916	No	S
<i>hirsuta</i> (Hall) 1933a	No	T (Hall 1933a)
<i>lithogaster</i> (Curran and Walley) 1934	No	T (Curran and Walley 1934)
<i>nephele</i> Lopes 1941	No	T (Lopes 1941)
<i>pexata</i> (Van der Wulp) 1896	Ne, No	T (Aldrich 1930)
<i>setifacies</i> Lopes 1945a	No	T (Lopes 1945a)
<i>spectabilis</i> (Aldrich) 1916	Ne	D (Aldrich 1916)
<i>unicinata</i> (Hall) 1933a	No	T (Hall 1933a)

#### Genus *Euboettcheria* Townsend

*Euboettcheria* Townsend 1927. Rev. Mus. Paulista. 15:231. Genotype *Euboettcheria australis* Tns.

*Ctenolioproctia* Enderlein 1928a. Klass. Sarc., p. 27. Genotype *Ctenolioproctia venusta* End. equals *Euboettcheria australis* Tns.

Frontal row divergent in last 3 bristles; outer verticals absent; 3 post-ocular rows; PSDC 4 weak—2 strong; 8 hypopleurals; scutellars 3-0-1; 2A with laterals only; 3A with MM; 1V bare; hind tibiae villous; 5S as in Fig. 306; corpus tubular, greatly elongated, Fig. 307; median filaments present; no juxta or vesica.

All the members of this genus, as far as is known, are Mexican and South American and from the West Indies. The biology is not known.

Included Species		
<i>anguilla</i> (Curran and Walley) 1934	No	T (Curran and Walley 1934)
<i>asinoma</i> Hall 1938	No	D (Hall 1938)
<i>australis</i> Townsend 1927	No	S
<i>collusor</i> (Curran and Walley) 1934	No	T (Curran and Walley 1934)
<i>epimelia</i> (Lopes) 1938a	No	D (Lopes 1938a)



<i>florencioi</i> (Prado and Fonseca) 1932	No	T (Prado and Fonseca 1932)
<i>naides</i> Lopes 1941	No	D (Lopes 1941)
<i>nicasia</i> Lopes 1941	No	D (Lopes 1941)
<i>percussa</i> (Lopes) 1938b	No	T (Lopes 1938b)
<i>volucris</i> (Van der Wulp) 1896	Ne	T (Aldrich 1930)

#### Genus *Sarcodexia* Townsend

***Sarcodexia*** Townsend 1892c. Jour. Inst. Jam. 1:105. Genotype *Sarcodexia sternodontis* Tns. equals *Sarcophaga lambens* Wied.

***Cricobrachia*** Enderlein 1928a. Klass. Sarc., p. 19. Genotype *Cricobrachia anisitsiana* End. congeneric with *S. sternodontis* Tns. teste Tns. 1938. Aldrich (1930) mentions that Townsend saw Enderlein's type and considered them as synonyms.

Frontal row divergent in last 2 bristles; outer verticals absent; 3 post-ocular rows; 4 PSDC; anterior acrosticals present; scutellars 2-1-1; 2A with only laterals; 3A with MM to row; 1V bare; hind tibiae bare; 5S as in Fig. 303; median filaments present; juxta large and complex; forked from its base, Fig. 302; no vesica.

This is a West Indian and South American species. It also occurs in southern United States. It has been reared from Coleoptera, Orthoptera, and Lepidoptera, Aldrich (1916). Thompson (1943-47) lists it as parasitic on *Strategus* and various Hemiptera and Lepidoptera. McCallan (1947) also lists it from Lepidoptera (*Sacadodes pyralis*). James (1947) cites cases of it as a myiasis producer and also mentions its being reared from carrion and dung.

#### SUBTRIBE BOETTCHERIINA

This subtribe is characterized by possessing median process and lateral filaments which are formed from the ventral sclerotization and are well developed before they split apart (see Chart 3). This distinguishes it from the *Sarcophagina* and *Raviniina* where the split takes place first. Also here the median process is always free, never fused to the juxta as in the *Sarcophagina*. The juxta is present in all but a few aberrant genera. The anterior juxtal process is present only in a few genera of this subtribe.

As far as is known, the Boettcheriina is entirely New World in distribution.

Little is known concerning the biology of the species. Those that are known are mainly parasitic.

See Chart 8 for the evolution of the genera and species.

#### Genus *Rafaelia* Townsend

***Rafaelia*** Townsend 1917a. Proc. Biol. Soc. Wash., 30:45. Genotype *Rafaelia rufiventris* Tns.

Frontal bristles barely divergent; outer verticals present; 2 post-ocular

rows; 3 PSDC; anterior acrosticals present or absent; 4 to 7 hypopleurals; scutellars 3-1-0 or 2-1-1; 2A with laterals only; 3A with MM; 1V setulose; hind tibiae bare; juxta small; median process and lateral filaments connected, Figs. 311, 314; vesica poorly developed, plate-like, Figs. 310, 313.

This genus is North American in distribution. The biology is not known.

#### Included Species

<i>ampulla</i> (Aldrich) 1916	Ne	S
<i>rufiventris</i> Townsend 1917a	Ne	S

#### Genus *Metoposarcophaga* Townsend

Frontal row hardly divergent to divergent in last 3 bristles; outer verticals present; 3 or 4 post-ocular rows; 3 or 4 PSDC; anterior acrosticals present; 6 to 9 hypopleurals; scutellars generally 2 or 3-1-0; weak apicals sometimes present; 2A with only laterals; 3A with or without MM; 1V setulose or bare; hind tibiae villous or bare; 5S with short base and no window, Fig. 320, 325; phallophore hooked behind at base, Figs. 316, 326; corpus capsule-like and smoothly surfaced; often projecting caudally; Figs. 316, 327; juxta and free median process and lateral filaments present; vesica connate and plume-like, Figs. 316, 324; genital segments greatly protuberant, Fig. 460; anal plates large, Figs. 333, 334.

#### Key to Subgenera—Males

1. 3 posterior dorsocentrals; hind tibiae bare. . . . . *Metoposarcophaga*
- 4 posterior dorsocentrals; hind tibiae villous. . . . . *Zygastropyga*

#### Subgenus *Metoposarcophaga* Townsend

*Metoposarcophaga* Townsend 1917a. Proc. Biol. Soc. Wash. 30:46.

Genotype *Sarcophaga pachyprocta* Park. equals *Sarcophaga importuna* Walk.

Frontal row barely divergent; 3 PSDC; hind tibiae bare, 1V setulose; corpus rounded, not much produced behind; Fig. 324; juxta narrow and bifurcate, Fig. 324; vesica with brush of upcurved bristles and hairs; 5S as in Fig. 321.

Both species in this subgenus are North American as far as is known at present. *M. importuna* has been bred from terrapin eggs, Aldrich (1916).

#### Included Species

<i>importuna</i> (Walker) 1848	Ne	S
<i>pachyprocta</i> Parker 1919a	Ne	D (Parker 1919a)

#### Subgenus *Zygastropyga* Townsend

*Zygastropyga* Townsend 1917b. Proc. Biol. Soc. Wash. 30:191. Genotype *Zygastropyga aurea* Tns.

*Thelylepticocnema* Townsend 1917a. Proc. Biol. Soc. Wash. 30:43. Genotype *Sarcophaga incurva* Ald.



**Sabinata** Parker 1921. Proc. Brook. Ent. Soc. 16:112. Genotype *Sabinata catalina* Park. equals *Sarcophaga villipes* Wulp.

Frontals barely divergent or divergent in last 2 or 3 bristles; 4 PSDC; scutellars 2 or 3-1-0; 1V bare or setulose; hind tibiae villous; juxta broad and fused, Fig. 326; or small and free, Fig. 317; corpus generally projecting behind; 5S as in Figs. 320, 325, 328; vesica with plumosity coarse, branch-like, Figs. 316, 326.

All the species placed here are North American in distribution. Their biology is not known.

#### Included Species

<i>aldrichi</i> (Parker) 1921	Ne	D (Parker 1921)
<i>arizonica</i> (Parker) 1921	Ne	D (Parker 1921)
<i>aurea</i> Townsend 1917b	Ne	S
<i>cantenea</i> (Roback) 1952	Ne	S
<i>incurva</i> (Aldrich) 1916	Ne	D (Aldrich 1916)
<i>sulculata</i> (Aldrich) 1916	Ne	S
<i>tothilli</i> Parker 1919a	Ne	D (Parker 1919a)
<i>villipes</i> (Van der Wulp) 1896	Ne	S

From Aldrich's (1930) description of *Tripanurga* B & B, type *Sarcophaga albicans* (Wied.), it appears that this genus will probably fall within the genus *Metoposarcophaga*. It differs from *Metoposarcophaga* in the possession of proclinate fronto-orbitals in the male and the lack of anterior acrosticals. The figures of the genitalia, however, seem to place it very close to the subgenus *Zygastropyga*. Should a future examination of specimens of *Sarcophaga albicans* place it within *Metoposarcophaga*, then *Metoposarcophaga* Tns. will fall to *Tripanurga* B & B.

#### Genus *Aphelomyia* new genus

Frontal row divergent in last 3 bristles; outer verticals not well developed, 3 post-ocular rows; 4 PSDC; anterior acrosticals present; scutellars 3-1-0; pair of weak apicals may be present; 2A with only laterals; 3A with only laterals; 1V bare; hind tibiae bare; 5S with short base and narrow arms, Fig. 332; corpus small, barrel-shaped, Fig. 330, vesica plumose, similar to *Metoposarcophaga*; genitalia as in Figs. 330-332.

Genotype and only species, *Sarcophaga welchi* Hall by present designation.

This species was described from Cuba and Florida. Its biology is unknown. Though aberrant for the subtribe Boettcheriina, it is placed here on the basis of the resemblance of its vesica to that of *Metoposarcophaga* Tns.

#### Genus *Boettcheria* Parker

**Boettcheria** Parker 1914b. Proc. Bost. Soc. Nat. Hist. 35:65. Genotype *Boettcheria latisterna* Park.

**Parasarcodexia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:192. Genotype *Sarcophaga parkeri* Ald.

Frontal row sharply divergent in last 4 or 5 bristles; outer verticals variable; 4 post-ocular rows; 3 PSDC; anterior acrosticals present; scutellars 2 or 3-1-1; 2A with laterals only; 3A generally with MM or row; 1V bare; hind tibiae bare or villous; 5S, Figs. 338, 344, deeply incised; vesica well developed, often very large and bizarre, Figs. 341, 346; median process and lateral filaments present; lateral filaments often very long and narrow, Fig. 346; phallopore and phallus partially fused.

Lopes (1950b) has summarized all the known data on the species of this genus. Only *B. carata* Roback can be added to his list of species.

#### Genus **Spirobolomyia** Townsend

**Spirobolomyia** Townsend 1917a. Proc. Biol. Soc. Wash. 30:43. Genotype *Sarcophaga singularis* Ald. equals *Sarcophaga pallipes* Walk. teste Tns. (1938).

Frontal row divergent in last 2 or 3 bristles; outer verticals absent; 3 post-ocular rows; 4 or 5 PSDC; anterior acrosticals present; scutellars 2-1-1; 2A with laterals only; 3A with MM; 1V bare; hind tibiae villous or bare; 5S as in Figs. 351, 354, 361, corpus hooked below, shaped as reversed K, Figs. 350, 352, 360; semi-sclerous foliate lateral plates present; median process and lateral filaments long and tubular; juxta small, Figs. 355, 360.

All three species are North American. *S. pallipes* (Walk.) has been reared from *Sparobolus* sp., Aldrich (1916) and *Julus* sp., Townsend (1917a, p. 43). *S. flavipalpis* (Ald.) has been also reared from *Sparobolus* sp., Aldrich (1916).

	Included Species	
<i>basalis</i> (Walker) 1852	Ne	S
<i>flavipalpis</i> (Aldrich) 1916	Ne	S
<i>pallipes</i> (Walker) 1852	Ne	S

#### Genus **Kellymyia** Townsend

**Kellymyia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:191. Genotype *Sarcophaga kellyi* Ald.

Frontal row divergent in last 3 bristles; outer verticals absent; 4 post-ocular rows; 4 PSDC; anterior acrosticals present; scutellars 2-1-1; 2A with only laterals; 3A with complete row; 1V and hind tibiae bare; 5S as in Fig. 308; corpus thin and apically curved in profile, Fig. 309; lateral plates vertically ovate, semi-sclerous, foliate, Fig. 309; no median process or filaments.

Though aberrant for the subtribe, *Kellymyia* is placed close to *Spirobolomyia* on the basis of the lateral plates.

The genotype is the only species and is a common North American



grasshopper parasite. Thompson (1943) lists it as a parasite of *Glossina palpalis* in the Upper Congo (?). Van Enden (1950) records it from *Asida*, *Eleodes*, and *Plectodera*.

#### Genus *Cucullomyia* new genus

Frontal row barely divergent; outer verticals present; 2 post-ocular rows; 3 PSDC; anterior acrosticals absent; scutellars 2-1-0; 2A with only laterals; 3A with MM; 1V and hind tibiae bare; 5S as in Fig. 365; corpus with a roof-like semi-sclerous projection; juxta small; median process and lateral filaments small; phallus as in Fig. 362-364.

Genotype and only species *Sarcophaga pedunculata* Hall by present designation. The genitalia are different from any other known Sarcophagini. It is North American and the biology is unknown.

#### Genus *Tylomyia* new genus

Frontal row barely divergent; outer verticals present; 2 post-ocular rows; 4 PSDC; anterior acrosticals absent; scutellars 3-1-0; 2A with only laterals; 3A with MM; 1V setulose; hind tibiae bare; 5S as in Fig. 356; phallus large and striking, Fig. 357; median process and lateral filaments thick, elongate and knobbed distally, Figs. 357, 359.

Genotype and only species *Sarcophaga texana* Ald. by present designation.

It is a North American species and has been bred from animal carcasses and meat, Aldrich (1916).

#### SUBTRIBE SERVAISIINA

This subtribe is characterized by the modification of the ventral sclerotization without any division. The limen (*Acandotheca*), the cunabula (*Servaisia*), and the stemmatis (*Fletcherimyia*) are the structures developed in each of the three genera of this subtribe. Most of its members are parasites. See Chart 9 for the evolution of the genera and species of this subtribe.

#### Genus *Fletcherimyia* Townsend

**Fletcherimyia** Townsend 1917b. Proc. Biol. Soc. Wash. 30:191. Genotype *Sarcophaga fletcheri* Ald.

**Peltopyga** Townsend 1917b. Proc. Biol. Soc. Wash. 30:191. Genotype *Sarcophaga celarata* Ald.

Frontal row divergent in last 2 or 3 bristles; outer verticals present or absent; 3 or 4 post-ocular rows; 3 or 4 PSDC; a small fifth may be present; anterior acrosticals absent; 7 hypopleurals; scutellars 2-1-1; discal and apical may be absent in *F. fletcheri*; 2A with MM in *F. fletcheri*; 3A with MM in all species; hind tibiae bare; 1V bare; 5S deeply incised with secondary internal peak, Figs. 369, 371, 373; stemmatis present, Figs.

370, 376; juxta two broad, lightly colored flaps, haired dorsally, Figs. 366, 367.

All the species are found in eastern North America and live in the cups of species of *Sarracenia*. They apparently feed on both dead and living insects in the cups.

	Included Species	
<i>celarata</i> (Aldrich) 1916	Ne	S
<i>fletcheri</i> (Aldrich) 1916	Ne	S
<i>jonesi</i> (Aldrich) 1916	Ne	S
<i>rileyi</i> (Aldrich) 1916	Ne	S

#### Genus *Kurtomyia* new genus

Frontal rows sharply divergent in last 2 or 3 bristles; outer verticals vestigial; ocellars small; 3 post-ocular rows; 3 PSDC; 2 or 3 anterior acrosticals; scutellars 2-1-1; apicals small; propleura bare; 2A and 3A with only lateral bristles; hind tibiae moderately villous; 1V bare; corpus thin in profile, curved forward apically, Fig. 410; slightly divided at apex in frontal view, Fig. 409; vesica divided, Fig. 409.

Genotype *Sarcophaga postilla* Reinhard by present designation.

The genitalia show no relationship to any other known Sarcophagini. The fifth sternite is very much like those found in the genera *Servaisia* and *Acandotheca* and places this genus near them within the Servaisiina.

#### Genus *Servaisia* Robineau-Desvoidy

Frontal row divergent in last 2 or 3 bristles; outer verticals generally absent; 3 or 4 post-ocular rows; 3 or 4 PSDC; anterior acrosticals generally present; scutellars 2 or 3-1-1; 2A with laterals only; 3A with MM to row; hind tibiae bare; 1V bare; anal forceps indented at base, Fig. 456, or reverse L-shaped, Fig. 458; spines or hairs on outer side below; cunabula, Figs. 382, 384, 385, 396, present; explanate vesica, Figs. 382, 392, and juxta, Figs. 396, 398, 403, present or absent; 5S with short base and bumps on inner edges of sternal arms, Figs. 394, 404.

The members of this genus are united in the possession of the cunabula by all and the explanate vesica by most of its members. Each of the subgenera represents a line of development within the genus. See Chart 9.

The following species have been placed in the genera *Sarcophaga* Meig., *Blaesoxipha* Loew, *Locustaevora* Rohd., and *Gesneroides* Vill. At present they cannot be definitely placed in any of the subgenera proposed here. Most will fall in the genus *Servaisia* but a few, as is the case with *B. arenicola* Rohd., will fall in *Acandotheca*. Should *B. laticornis* Meig. (equals *grylloctona* Loew) prove to be congeneric under the generic concepts proposed here, then *Servaisia* R.-D. will fall to *Blaesoxipha* Loew.



## Included Species

<i>acuminata</i> (Villeneuve) 1912d	P	T (Séguy 1941b)
<i>alopecis</i> (Reinhard) 1947	Ne	T (Reinhard 1947)
<i>asiatica</i> (Rohdendorf) 1928c	P	T (Séguy 1941b)
<i>aurulenta</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>baranoffi</i> (Senior-White) 1940	O	T (S.-White et al. 1940)
<i>battiliger</i> a (Séguy) 1941b	P	T (Séguy 1941b)
<i>binodonosa</i> (Curran) 1934a	E	T (Curran 1934a)
<i>carinata</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>cinereogrisea</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>cochlearis</i> (Pandellé) 1896	P	T (Séguy 1941b)
<i>confusa</i> (Villeneuve) 1912d	P	T (Séguy 1941b)
<i>convena</i> (Reinhard) 1947	Ne	T (Reinhard 1947)
<i>fasciventris</i> (Curran) 1934a	E	T (Curran 1934a)
<i>filipjevi</i> (Rohdendorf) 1928a	P	T (Séguy 1941b)
<i>flavipes</i> (Aldrich) 1916	Ne	T (Aldrich 1916)
<i>fossoria</i> (Pandellé) 1896	P	T (Séguy 1941b)
<i>fridolini</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>gemina</i> (Hardy) 1943	A	T (Hardy 1943)
<i>gladatrix</i> (Pandellé) 1896	P	T (Séguy 1941b)
<i>jakovlevi</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>kastneri</i> (Baranoff) 1932	O	T (S.-White et al. 1940)
<i>koslovi</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>laticornis</i> (Meigen) 1826	P	T (Séguy 1941b)
<i>lindneri</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>lineata</i> (Fallén) 1816	P	T (Séguy 1941b)
<i>litoralis</i> (Villeneuve) 1911b	P	T (Séguy 1941b)
<i>migratoriae</i> (Rohdendorf) 1928c	P	T (Séguy 1941b)
<i>occatrix</i> (Pandellé) 1896	P	T (Séguy 1941b)
<i>pagella</i> (Reinhard) 1947	Ne	T (Reinhard 1947)
<i>popovi</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>putilla</i> (Reinhard) 1947	Ne	T (Reinhard 1947)
<i>pygmaea</i> (Zetterstedt) 1845	P	T (Séguy 1941b)
<i>rossica</i> (Villeneuve) 1912d	P	T (Séguy 1941b)
<i>rubripes</i> (Villeneuve) 1912d	P	T (Séguy 1941b)
<i>shelkovnikova</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>silantjevi</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)
<i>subcochlearis</i> (Séguy) 1932b	P	T (Séguy 1941b)
<i>ungulata</i> (Pandellé) 1896	P	T (Séguy 1941b)
<i>unicolor</i> (Villeneuve) 1912d	P	T (Séguy 1941b)
<i>valangae</i> (Aldrich) 1932	O	T (S.-White et al. 1940)
<i>zachvatkini</i> (Rohdendorf) 1937	P	T (Rohdendorf 1937)

The majority of the species in the above list are parasitic on Orthoptera. See Séguy (1932a and 1941b) and Rohdendorf (1932 and 1937) for further details on the biology.

## Key to Subgenera—Males

1. Anal forceps short, reverse L-shaped, Fig. 458; large, partly sclerous plates on either side of corpus, Fig. 412 ..... **Speciosia**  
 Anal forceps not as above; of normal length and shape; indented

- near base, Fig. 456 .....2
2. Juxta absent; corpus short; cunabula as in Figs. 378, 382 **Protodexia**  
Juxta present .....3
3. Juxta very small; peaked; corpus elongate, constricted before apex,  
Fig. 389 .....**Sarpedia**  
Juxta well developed; bifurcate and spatulate, Figs. 396, 398; corpus  
short . . . . .4
4. Juxta forked; connected at base, Fig. 396; cunabula as in Figs. 392,  
393, 396 .....**Servaisia**  
Juxta separated at base, Figs. 403, 406; cunabula large and curved,  
Figs. 393, 401 .....**Acridophaga**

Subgenus **Acridophaga** Townsend

**Acridophaga** Townsend 1917a. Proc. Biol. Soc. Wash. 30:46. Genotype  
*Sarcophaga aculeata* Ald.

Cunabula well formed, curved in profile, Figs. 399, 407; explanate  
vesica partly sclerous; juxta completely divided at base.

The members of this subgenus are, as far as is known, all parasitic and  
are Nearctic, Neotropical, and Palearctic in distribution. Massini (1919)  
has given the biology of *S. caridei*.

Included Species		
<i>aculeata</i> (Aldrich) 1916	Ne	S
<i>aculeata gavia</i> (Aldrich) 1916	Ne	D (Aldrich 1916)
<i>aculeata taediosa</i> (Aldrich) 1916	Ne	D (Aldrich 1916)
<i>angustifrons</i> (Aldrich) 1916	Ne	S
<i>caridei</i> (Brèthes) 1906	Ne,No	S
<i>potanini</i> (Rohdendorf) 1928c	P	D (Rohdendorf 1932)
<i>reversa</i> (Aldrich) 1916	Ne	S
<i>websteri</i> (Aldrich) 1916	Ne	D (Aldrich 1916)

Subgenus **Protodexia** Townsend

**Protodexia** Townsend 1912c. Jour. N. Y. Ent. Soc. 30:117. Genotype  
*Protodexia synthetica* Tns. equals *Sarcophaga hunteri* Hough.

**Opsophyto** Townsend 1915a. Proc. Biol. Soc. Wash. 28:23. Genotype  
*Sarcophaga opifera* Coq.

**Locustivora** Johnston and Tiegs 1922a. Proc. Biol. Soc. Queensland.  
34:187. Genotype *Masicera pachytyli* Skuse congeneric with *S. opi-*  
*fera* teste Tns. 1938.

Juxta absent; corpus moderately short, Figs. 377, 380; cunabula as in  
Figs. 378, 382; explanate vesica present or absent.

The members of this subgenus are all parasitic and Nearctic, and if  
Townsend's synonymy is correct, Australian in distribution. Lopes (1943)  
has reported *Protodexia* from Brazil.



Included Species

<i>arteagi</i> (Blanchard) 1939	No	T (Blanchard 1939)
<i>hunteri</i> (Coquillett) 1892	Ne	S
<i>hunteri aenigma</i> (Reinhard) 1947	Ne	D (Reinhard 1947)
<i>opifera</i> (Coquillett) 1892	Ne	S
<i>pachytyli</i> (Skuse) 1891	A	D (Hardy 1943)

Subgenus **Sarpedia** new subgenus

Juxta very small, peaked, Fig. 390; corpus elongate, constricted before tip, Fig. 389.

Genotype *Sarcophaga setigera* Ald. by present designation.

*S. setigera* is Nearctic in distribution and a parasite. Branch (1920) has recorded it from a mantid. It is a web spinner, the only such case known in the Sarcophagini.

Included Species

<i>lorena</i> (Roback) 1952	Ne	S
<i>setigera</i> (Aldrich) 1916	Ne	S

Subgenus **Servaisia** Robineau-Desvoidy

**Servaisia** Robineau-Desvoidy 1863. Hist. Dipt. 2:429. Genotype *Sarcophaga erythrura* Meigen.

Juxta well developed, Figs. 385, 396, bifurcate, connected at base; explanate vesica and cunabula present; Figs. 383-387 and 391-396.

The members of this subgenus are entirely parasitic. At present its distribution is Nearctic and Palearctic, and when more species can be definitely placed it probably will extend into the Oriental and Australian regions.

Included Species

<i>coloradensis</i> (Aldrich) 1916	Ne	S
<i>erythrura</i> (Meigen) 1826	P	S
<i>falciformis</i> (Aldrich) 1916	Ne	S
<i>formosa</i> (Rohdendorf) 1928a	P	D (Rohdendorf 1928a)
<i>uncata</i> (Van der Wulp) 1896	Ne	S

Subgenus **Speciosia** new subgenus

Well-developed cunabula present, Fig. 412; explanate vesica apparently represented by 2 large lateral plates on either side of corpus; corpus with hook-like projections antero-laterally.

Genotype and only species *Fletcherimyia speciosa* Lopes by present designation.

This is the most aberrant subgenus of *Servaisia*, but the presence of the cunabula and the shape of the fifth sternite, Fig. 411, place it here. It is Nearctic in distribution and the biology is unknown.

Genus **Acandotheca** Townsend

Frontal row divergent in last 2 or 3 bristles; outer verticals variable;

3 or 4 post-ocular rows; 3 or 4 PSDC; anterior acrosticals variable; scutellars 2 or 3-1-1; apicals rarely absent; 2A with only laterals; 3A with MM to complete row; 1V setulose or bare; hind tibiae bare; anal forceps indented near base; spines or hairs on outer side below, Fig. 456; fifth sternite with short base and protuberance on inner edges of sternal arms, Figs. 422, 426, 430; limen present; juxta, explanate vesica and copi, Figs. 427-441, may be present. Figs. 414-431.

The members of this genus are held together by the presence of the limen, the shape of 5S, and the anal forceps. Several lines of development within it are represented by the subgenera. See Chart 9.

#### Key to Subgenera—Males

1. Copi present, Figs. 427, 448, 432 ..... **Acandotheca**  
     Copi absent ..... 2
2. Juxta present ..... **Tephromyiella**  
     Juxta absent ..... 3
3. First vein bare; genitalia as in Fig. 414 ..... **Stenolaucotheca**  
     First vein setulose ..... 4
4. Three posterior dorsocentrals; explanate vesica present, Figs. 423..  
     ..... **Lepyria**  
     Four posterior dorsocentrals; vesica present, Fig. 420 **Mecynocarpus**

#### Subgenus *Acandotheca* Townsend

*Acandotheca* Townsend 1917c. Ins. Ins. Mens. 5:159. Genotype *Sarcophaga prohibita* Ald.

*Eleodiomyia* Townsend 1917c. Ins. Ins. Mens. 5:160. Genotype *Sarcophaga eleodis* Ald.

*Sarcophodexia* Townsend 1917c. Ins. Ins. Mens. 5:161. Genotype *Sarcophaga hamata* Ald.

*Notochaetopsis* Townsend 1917c. Ins. Ins. Mens. 5:162. Genotype *Sarcophaga masculina* Ald.

*Hamatomyia* Blanchard 1939. Physis 18:816. Genotype *Hamatomyia denieri* Blanchard.

PSDC 3 or 4; juxta present, tips pointed, Figs. 428, 434; copi present, Figs. 427-441; explanate vesica well developed only in *Acandotheca complosa* (Rein.) and *Acandotheca eleodis* (Ald.)

The species of this subgenus are Nearctic and Neotropical in distribution and, as far as known, mostly parasitic. Van Emden (1950) lists *A. eleodis* from *Asida* and *Eleodes*. Thompson (1943) lists *A. rudis* from *Ligyris* and *A. prohibita* from *Lachnosterna*.

#### Included Species

<i>alcedo</i> (Aldrich) 1916	Ne	S
<i>complosa</i> (Reinhard) 1947	Ne	S



<i>denieri</i> (Blanchard) 1939	No	D (Blanchard 1939)
<i>eleodis</i> (Aldrich) 1916	Ne	S
<i>excisa</i> (Aldrich) 1916	Ne	D (Aldrich 1916)
<i>hamata</i> (Aldrich) 1916	Ne	S
<i>magna</i> (Aldrich) 1916	Ne	D (Aldrich 1916)
<i>masculina</i> (Aldrich) 1916	Ne	S
<i>prohibita</i> (Aldrich) 1916	Ne	S
<i>reperta</i> (Reinhard) 1947	Ne	D (Reinhard 1947)
<i>rudis</i> (Aldrich) 1916	Ne,No	S
<i>spretor</i> (Reinhard) 1947	Ne	D (Reinhard 1947)
<i>wagneri</i> (Blanchard) 1939	No	D (Blanchard 1939)

Subgenus **Lepyria** new subgenus

Three PSDC; IV setulose; explanate vesica present, Fig. 424; corpus semi-globose; with antero-ventral hooks; highly modified limen present; no juxta or copi; Figs. 422-424.

Genotype and only species *Sarcophaga melampyga* Ald. by present designation.

Its distribution is Nearctic and its biology is unknown.

Subgenus **Mecynocorpus** new subgenus

Four PSDC; IV setulose; vesica present; corpus with a midcaudal hook-like extension; limen very large, Fig. 420; anal forceps very sharply hooked, Fig. 457.

Genotype and only species *Sarcophaga salva* Ald. by present designation.

It is a Nearctic species of unknown biology.

Subgenus **Stenolaucotheca** Townsend

**Stenolaucotheca** Townsend 1918. Ins. Ins. Mens. 6:162. Genotype *Sarcophaga spatulata* Ald.

IV bare; explanate vesica present; limen, Fig. 414, appearing as vertical rectangle with hook below; no juxta or copi; corpus long; Figs. 413-415.

The genotype above is the only included species. It is Nearctic and probably parasitic.

Subgenus **Tephromyiella** Townsend

**Tephromyiella** Townsend 1917c. Ins. Ins. Mens. 5:164. Genotype *Sarcophaga atlanis* Ald.

IV bare; vesica small; large scoop-like juxta present, Fig. 416; limen large and well developed; no copi; see Figs. 416-418.

The species of this subgenus are found in the Nearctic and Palearctic regions and are parasitic, mostly on Orthoptera.

Included Species

<i>atlanis</i> (Aldrich) 1916	Ne	S
<i>arenicola</i> (Rohdendorf) 1928a	P	D (Rohdendorf 1928a)
<i>devulsa</i> (Reinhard) 1947	Ne	T (Reinhard 1947)

## VII. Abbreviations Used in Text and Plates

A—Sternal arms.	LP—Lateral plate.
AC—Anterior clasper.	MC—Membranocorpus.
AF—Anal forceps.	MDP—Median dorsal projection.
AJ—Anterior juxtal process.	MF—Median filament.
AP—Anal plate.	MP—Median process.
B—Sternal base.	MM—Median marginals.
C—Corpus.	PC—Posterior claspers.
CA—Capitis.	PH—Phallus.
CO—Copi.	PHO—Phallophore.
CU—Cunabula.	PSDC—Posterior dorsocentrals.
DR—Dorsal rods.	PT—Phallic tube.
H—Harpes.	SC—Sclerocorpus.
HI—Hillae.	ST—Stemmatis.
J—Juxta.	V—Vesica.
L—Limen.	VS—Ventral sclerotization.
LA—Lateral arms.	W—Sternal window.
LDP—Lateral dorsal projection.	2A-7A—Abdominal segments.
LF—Lateral filament.	2S-6S—Abdominal sternites.
LJ—Lateral juxtal process.	1V-5V—Wing veins.



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PLATES WITH EXPLANATIONS

PLATE 1

FIG. 1. Hypothetical sarcophagine aedeagus, lateral view.

*Scopeuma stercorarium* (Linnaeus)

FIG. 2. Fifth sternite.

FIG. 3. Aedeagus, lateral view.

FIG. 4. Phallus, antero-dorsal view.

FIG. 5. Anal plate and forceps, lateral view.

*Spathiophora cincta* Loew

FIG. 6. Fifth sternite.

FIG. 7. Aedeagus, lateral view.

FIG. 8. Phallus, anterior view.

*Senotainia trilineata*, var *argentifrons* Townsend

FIG. 9. Aedeagus, lateral view.

*Agria affinis* (Fallén)

FIG. 10. Fifth sternite.

FIG. 11. Phallus, ventral view—phallic tube omitted.

FIG. 12. Phallus, anterior view.

FIG. 13. Phallus, lateral view.



PLATE I

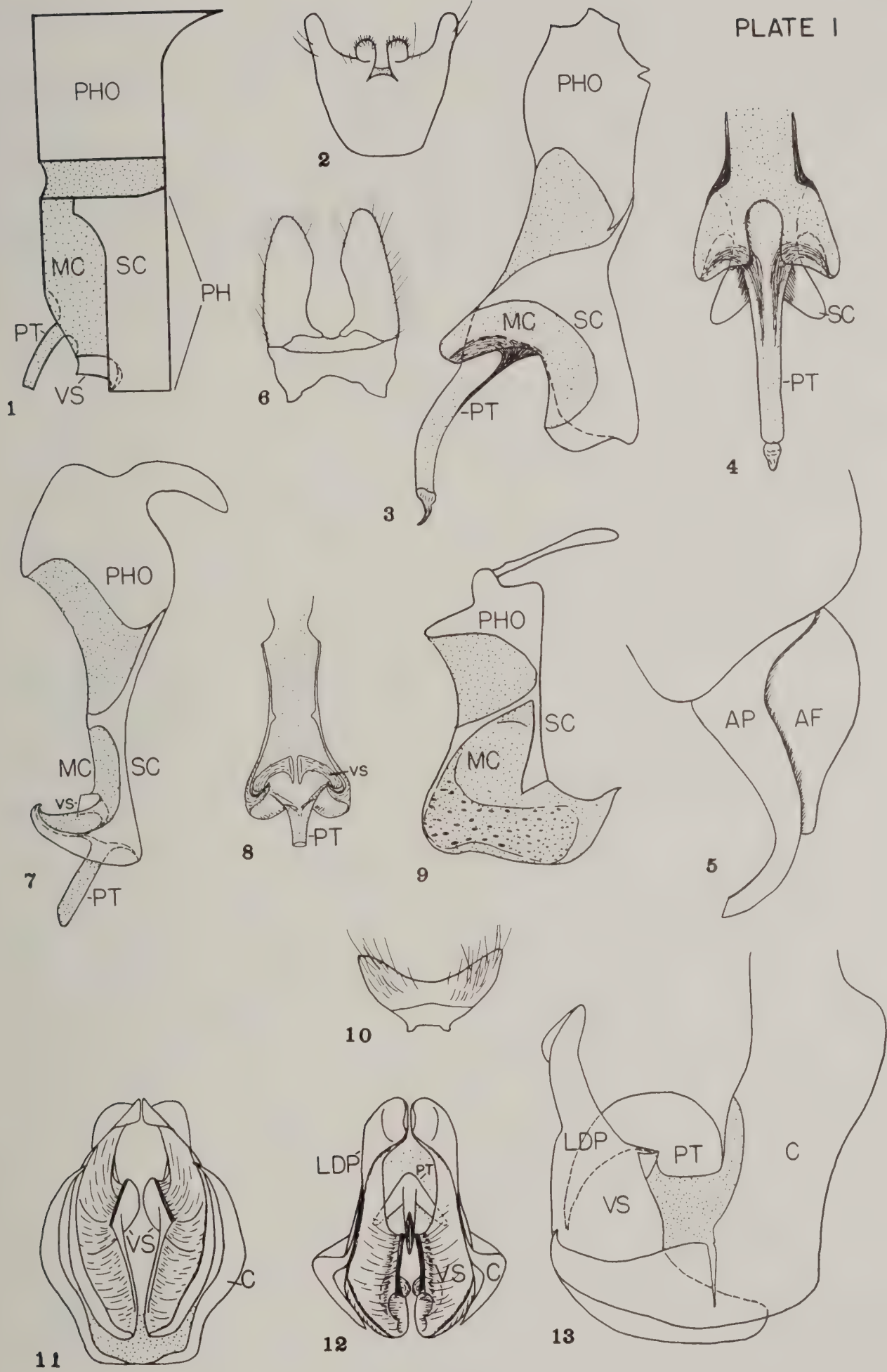


PLATE 2

*Sarcofahrtia ravinia* Parker

- FIG. 14. Phallus, lateral view.  
FIG. 15. Phallus, anterior view.  
FIG. 16. Fifth sternite.

*Wohlfahrtia vigil* (Walker)

- FIG. 17. Fifth sternite.  
FIG. 18. Tip of phallus, anterior view.  
FIG. 19. Phallus, lateral view.

*Imparia impar* (Aldrich)

- FIG. 20. Phallus, anterior view.  
FIG. 21. Phallus, left lateral view.  
FIG. 22. Phallus, right lateral view.  
FIG. 23. Fifth sternite.

*Sarcophagula femoralis* (Schiner)

- FIG. 24. Fifth sternite.  
FIG. 25. Aedeagus, lateral view.  
FIG. 26. Lateral arms and median process, caudo-ventral view.  
FIG. 27. Tip of phallus, anterior view.

*Sarcophagula occidua* (Fabricius)

- FIG. 28. Fifth sternite.  
FIG. 29. Aedeagus, lateral view.



PLATE 2

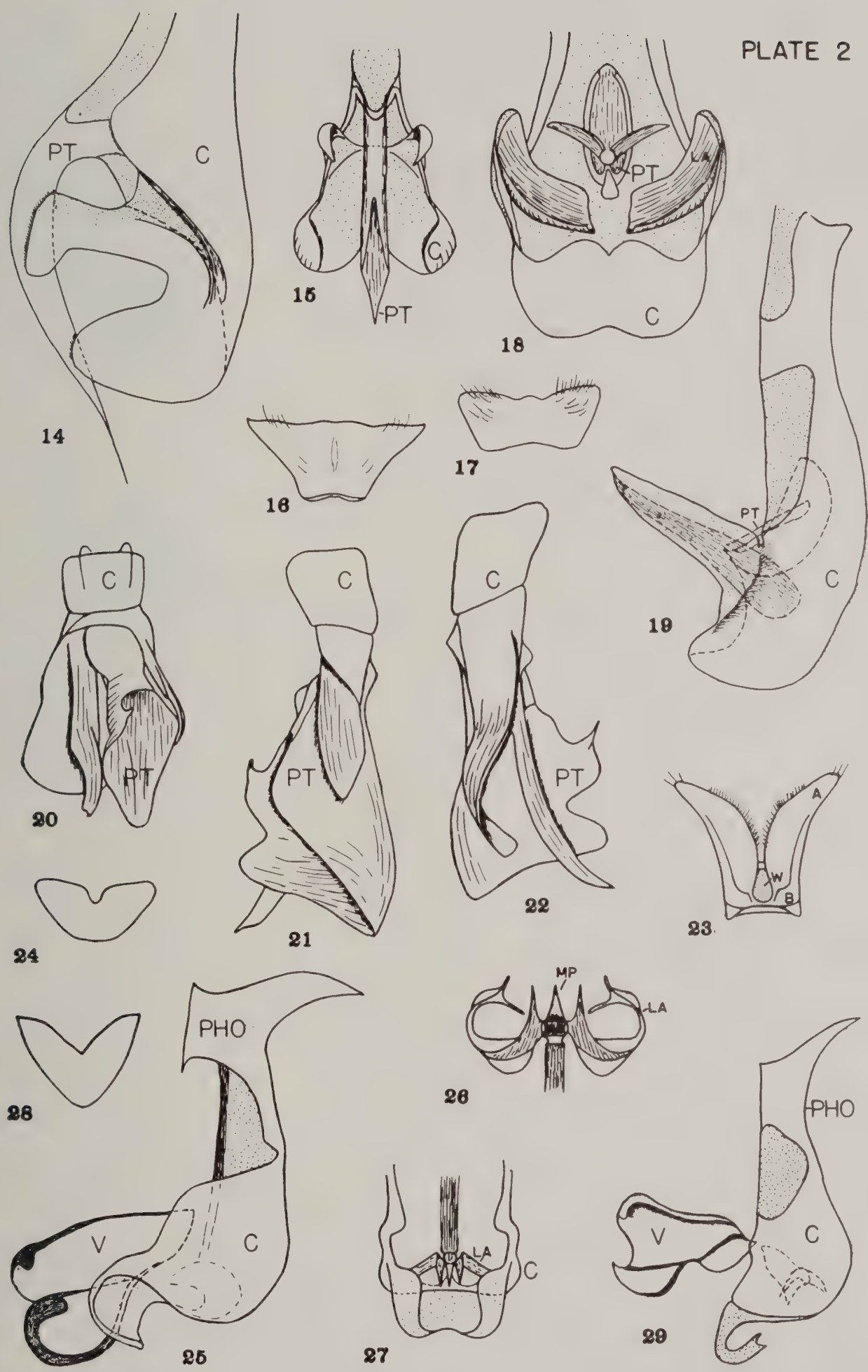


PLATE 3

*Hypopelta scrofa* Aldrich

FIG. 30. Phallus, caudal view.

FIG. 31. Juxta and filaments, antero-dorsal view.

FIG. 32. Phallus, lateral view.

*Camptops unicolor* Aldrich

FIG. 33. Attachment of right lateral filament to corpus, mesodorsal view.

FIG. 34. Phallus, anterior view.

FIG. 35. Fifth sternite.

FIG. 36. Phallus, lateral view.

*Argoravinia modesta* (Wiedemann)

FIG. 37. Fifth sternite.

FIG. 38. Phallus, caudal view.

FIG. 39. Phallus, lateral view.

*Chloronesia* sp.

FIG. 40. Juxta, ventral view.

FIG. 41. Phallus, lateral view.

FIG. 42. Fifth sternite.

*Johnsonia* (*Johnsonia*) sp.

FIG. 43. Fifth sternite.

FIG. 44. Phallus, lateral view.



PLATE 3

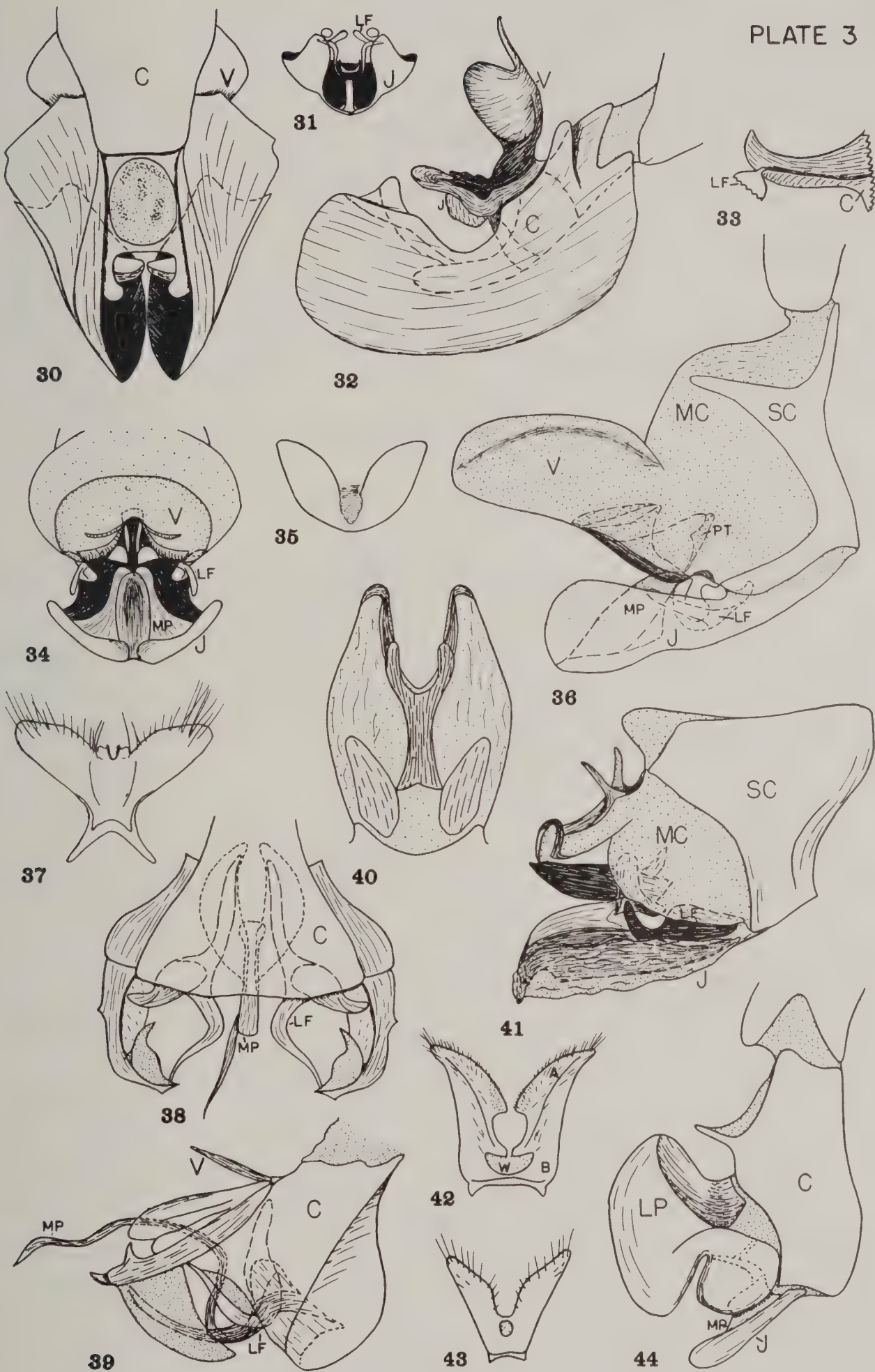


PLATE 4

*Johnsonia (Emblemasoma) erro* (Aldrich)

- FIG. 45. Phallus, lateral view.  
FIG. 46. Phallus, anterior view.  
FIG. 47. Fifth sternite.

*Johnsonia (Johnsonia) rufitibia* (Van der Wulp)

- FIG. 48. Phallus, lateral view.  
FIG. 49. Phallus, anterior view.  
FIG. 50. Juxta, ventral view.  
FIG. 51. Fifth sternite.

*Helicobia morionella* (Aldrich)

- FIG. 52. Phallus, lateral view.  
FIG. 53. Fifth sternite.  
FIG. 54. Juxta, median process and capitis, lateral view.  
FIG. 55. Juxta, ventral view.  
FIG. 56. Right lateral filament, lateral view.

*Helicobia rapax* (Walker)

- FIG. 57. Juxta, ventral view.  
FIG. 58. Aedeagus, lateral view.  
FIG. 59. Phallus, lateral view—lateral plates removed.  
FIG. 60. Fifth sternite.

*Helicobia stellata* (Van der Wulp)

- FIG. 61. Juxta, ventral view.  
FIG. 62. Phallus, lateral view.



PLATE 4

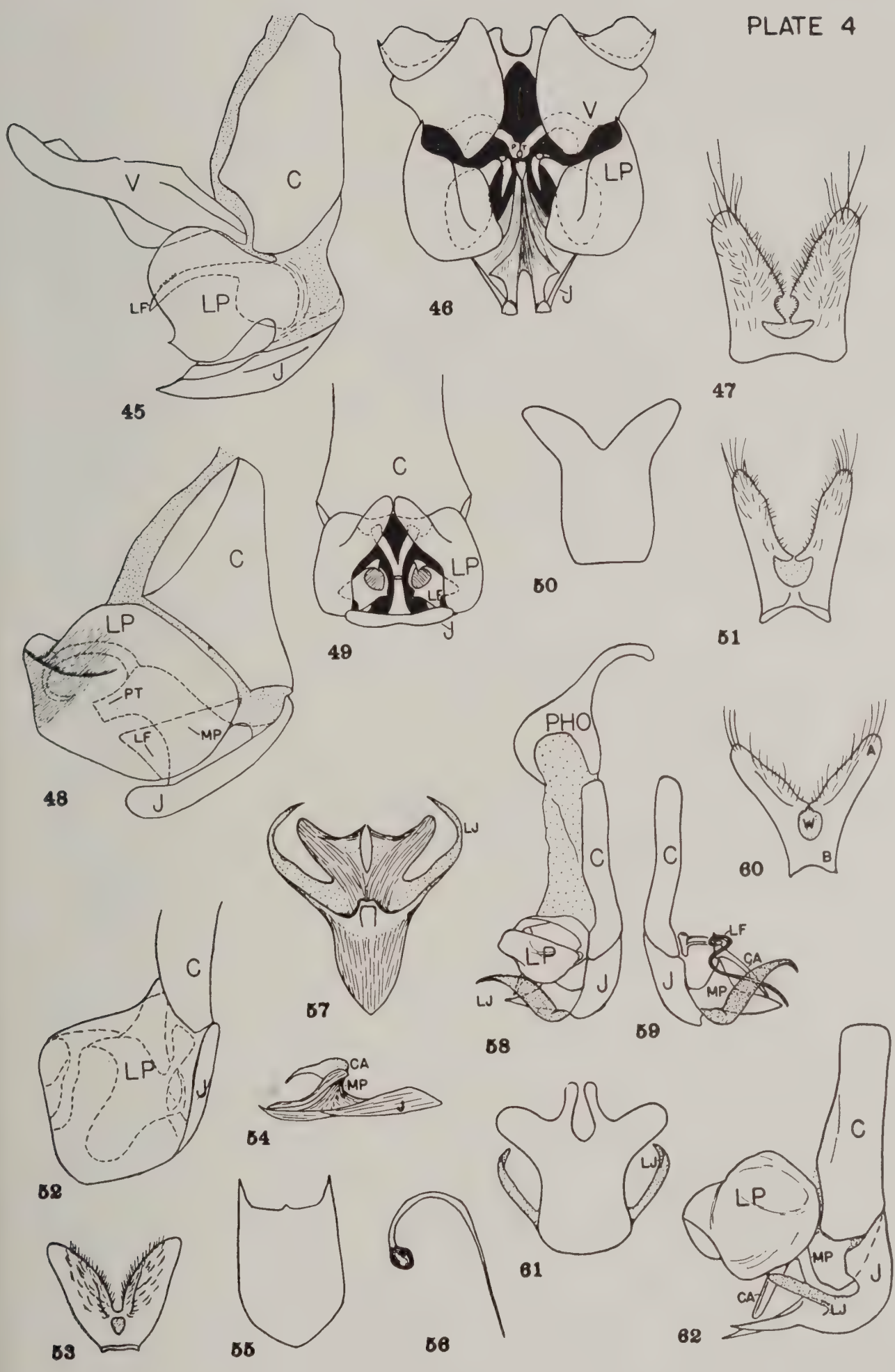


PLATE 5

*Helicobia australis* Johnston & Tiegs

FIG. 63. Phallus, lateral view.

FIG. 64. Juxta, median process and capitis, lateral view.

FIG. 65. Fifth sternite.

FIG. 66. Corpus, anterior view.

*Arachnidomyia hinei* (Aldrich)

FIG. 67. Fifth sternite.

FIG. 68. Phallus, lateral view.

FIG. 69. Juxta, median process and capitis, lateral view.

*Arachnidomyia davidsoni* (Coquillett)

FIG. 70. Juxta, median process and capitis, lateral view.

FIG. 71. Fifth sternite.

FIG. 72. Phallus, lateral view.

*Arachnidomyia houghi* (Aldrich)

FIG. 73. Juxta, median process and capitis, lateral view.

FIG. 74. Left lateral filament, anterior view.

FIG. 75. Phallus, lateral view.



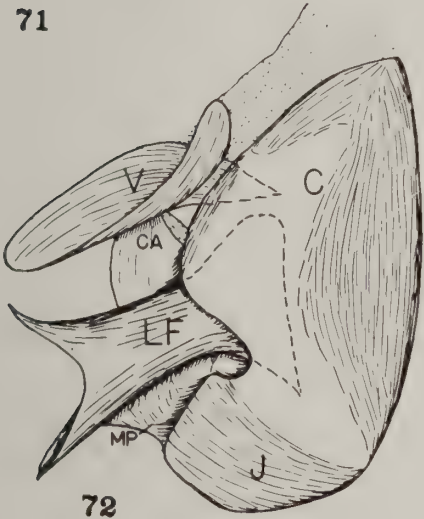
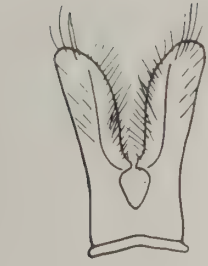
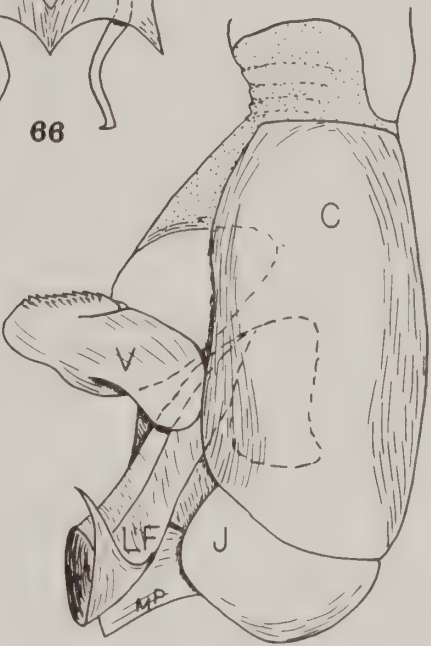
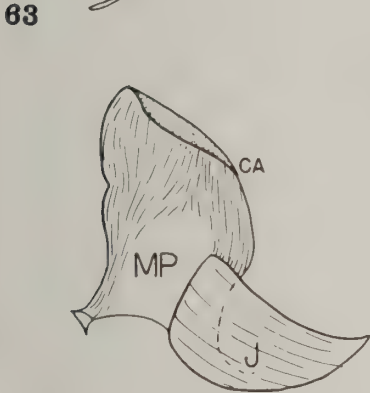
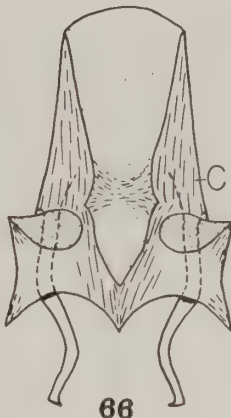
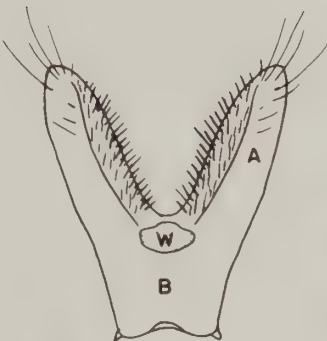
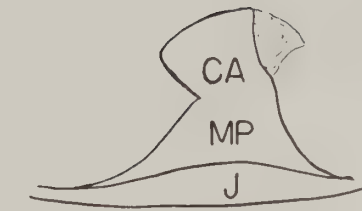
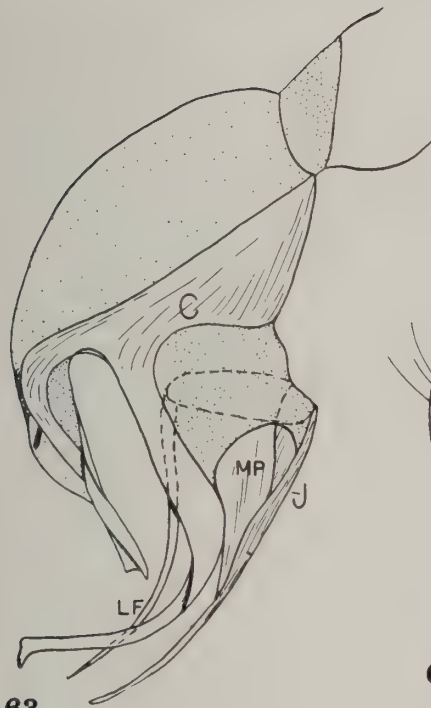


PLATE 6

*Arachnidomyia aldrichi* (Parker)

FIG. 76. Phallus, lateral view.

FIG. 77. Juxta, median process and capitis, lateral view.

FIG. 78. Left lateral filament, anterior view.

*Sarcomyia scelestus* (Hall)

FIG. 79. Phallus, lateral view.

FIG. 80. Phallus, anterior view.

FIG. 81. Fifth sternite.

*Wohlfahrtiopsis johnsoni* (Aldrich)

FIG. 82. Phallus, lateral view.

FIG. 83. Fifth sternite.

FIG. 84. Lateral filaments and capitis, dorsal view.

*Wohlfahrtiopsis bishoppi* (Aldrich)

FIG. 85. Fifth sternite.

FIG. 86. Phallus, lateral view.

*Wohlfahrtiopsis utilis* (Aldrich)

FIG. 87. Juxta, median process and capitis, lateral view.

FIG. 88. Fifth sternite.

FIG. 89. Phallus, lateral view.



PLATE 6



PLATE 7

*Sapromyia polistensis* (Hall)

- FIG. 90. Phallus, lateral view.  
FIG. 91. Fifth sternite.  
FIG. 92. Capitis and median process, lateral view.

*Sapromyia cooleyi* (Parker)

- FIG. 93. Phallus, lateral view.  
FIG. 94. Left lateral filament, anterior view.  
FIG. 95. Fifth sternite.  
FIG. 96. Juxta, ventral view.  
FIG. 97. Vesica, anterior view.  
FIG. 98. Juxta, median process and capitis, lateral view.

*Sapromyia bullata* (Parker)

- FIG. 99. Phallus, lateral view.  
FIG. 100. Juxta, ventral view.  
FIG. 101. Fifth sternite.  
FIG. 102. Juxta, median process and capitis, lateral view.

*Sarcophaga melanura* Meigen

- FIG. 103. Fifth sternite.  
FIG. 104. Phallus, lateral view.  
FIG. 105. Phallus, anterior view.

*Sarcophaga sinuata* Meigen

- FIG. 106. Left lateral filament, antero-mesal view.  
FIG. 107. Fifth sternite.  
FIG. 108. Juxta and median process, lateral view.  
FIG. 109. Phallus, lateral view.



PLATE 7

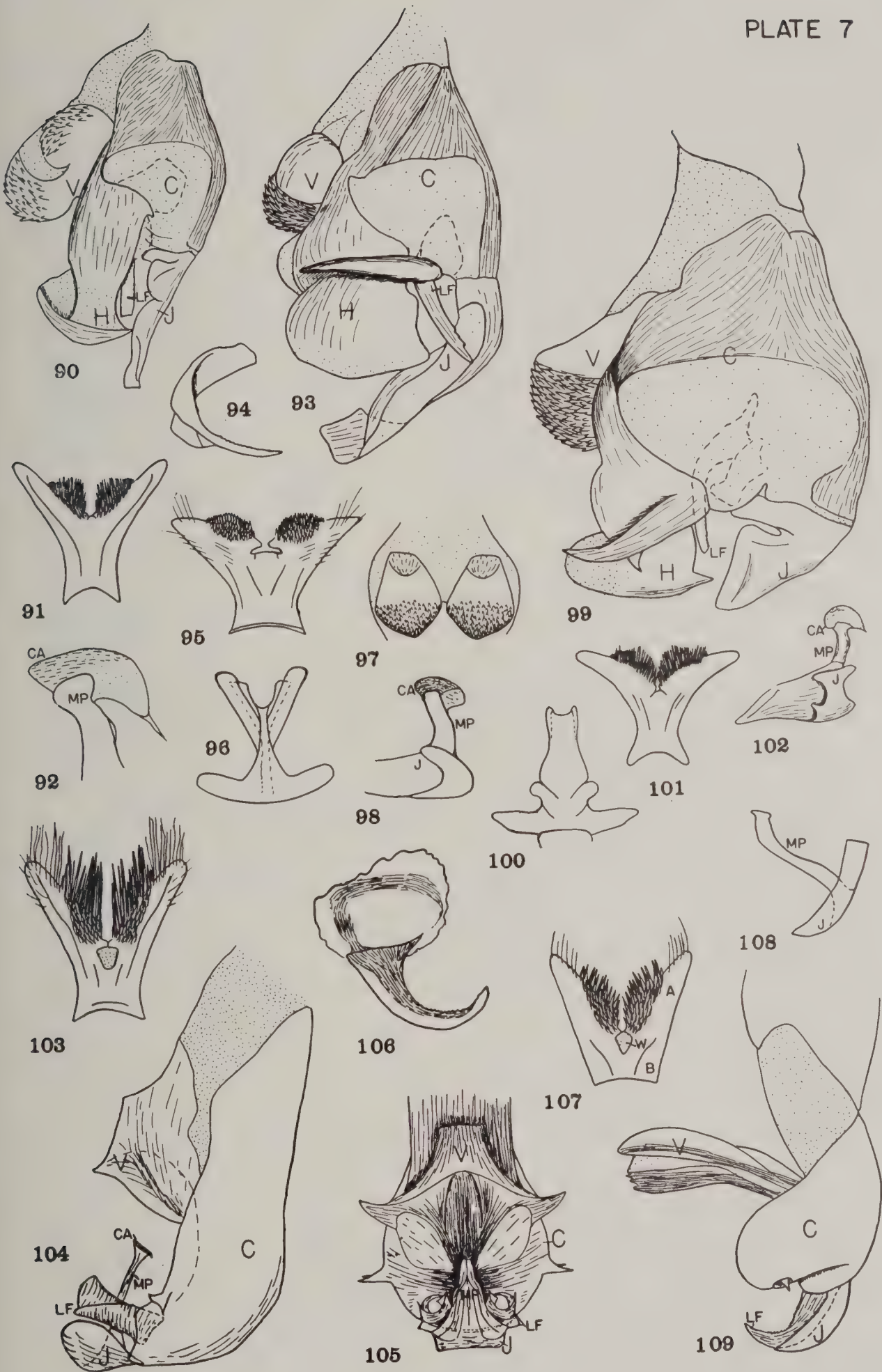


PLATE 8

*Sarcophaga vagans* Meigen

FIG. 110. Phallus, lateral view.

FIG. 111. Fifth sternite.

*Sarcophaga offuscata* Meigen

FIG. 112. Phallus, lateral view.

*Sarcophaga haemorrhoea* Meigen

FIG. 113. Phallus, lateral view.

FIG. 114. Fifth sternite.

FIG. 115. Phallus, anterior view.

*Sarcophaga cucullans* Pandellé

FIG. 116. Fifth sternite.

FIG. 117. Phallus, lateral view.

FIG. 118. Juxta, lateral juxtal process, median process and capitis, lateral view.

*Sarcophaga pumila* Meigen

FIG. 119. Phallus, anterior view.

FIG. 120. Phallus, lateral view.

FIG. 121. Capitis and median process, lateral view.

FIG. 122. Fifth sternite.

*Sarcophaga arcipes* Pandellé

FIG. 123. Fifth sternite.

FIG. 124. Phallus, lateral view.



PLATE 8

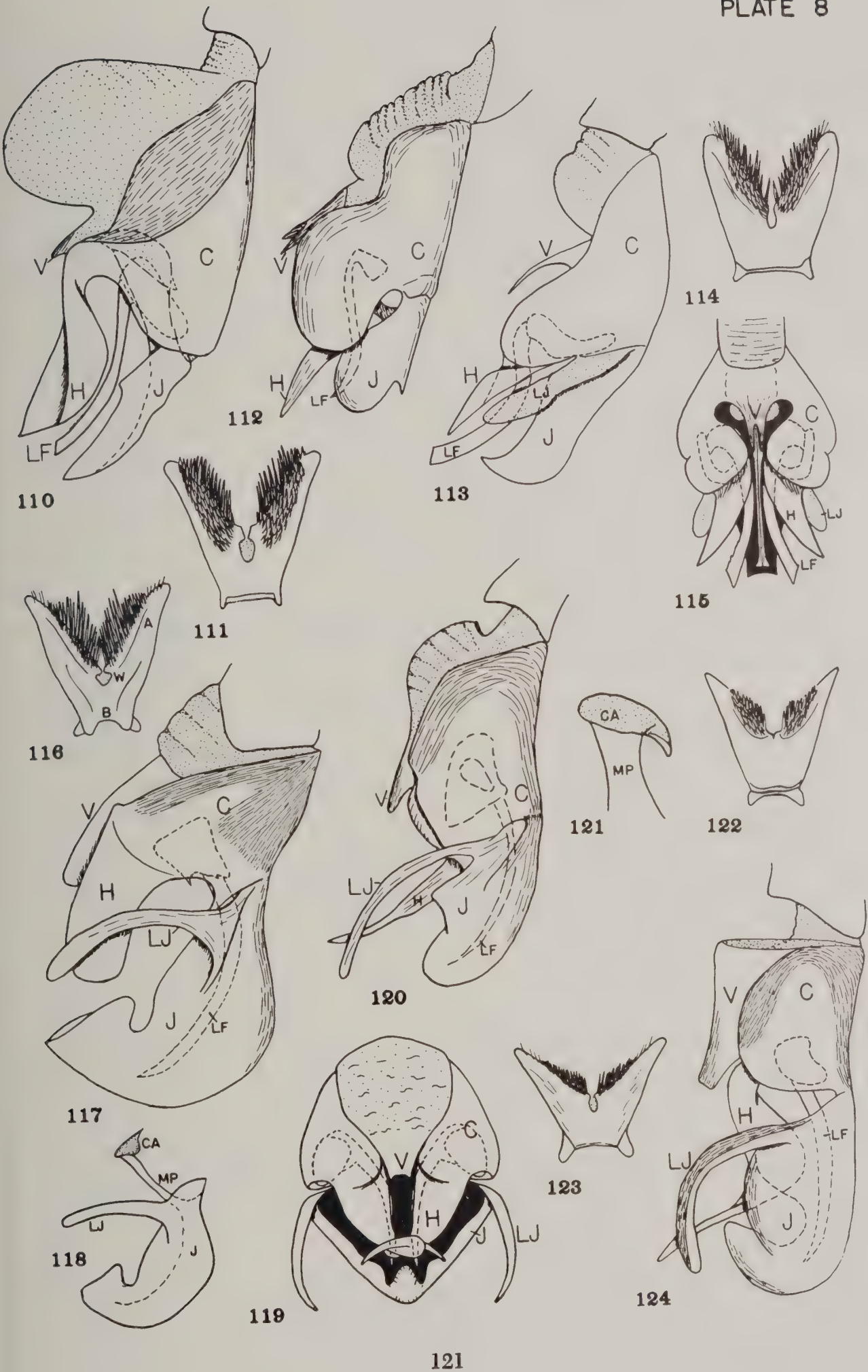


PLATE 9

*Sarcophaga exuberans* Pandellé

FIG. 125. Phallus, lateral view.

FIG. 126. Fifth sternite.

*Sarcophaga misera* Walker

FIG. 127. Fifth sternite.

FIG. 128. Phallus, lateral view.

FIG. 129. Juxta and lateral juxtal processes, caudo-ventral view.

*Sarcophaga sarracenioides* Aldrich

FIG. 130. Right lateral filament, caudal view.

FIG. 131. Phallus, lateral view.

FIG. 132. Fifth sternite.

FIG. 133. Juxta, lateral juxtal process, median process and capitis, lateral view.

FIG. 134. Vesica, dorsal view.

*Sarcophaga harpax* Pandellé

FIG. 135. Phallus, lateral view.

*Sarcophaga scoparia* var *nearctica* Parker

FIG. 136. Fifth sternite.

FIG. 137. Right lateral filament, anterior view.

FIG. 138. Phallus, lateral view.

FIG. 139. Juxta, median process and capitis, lateral view.



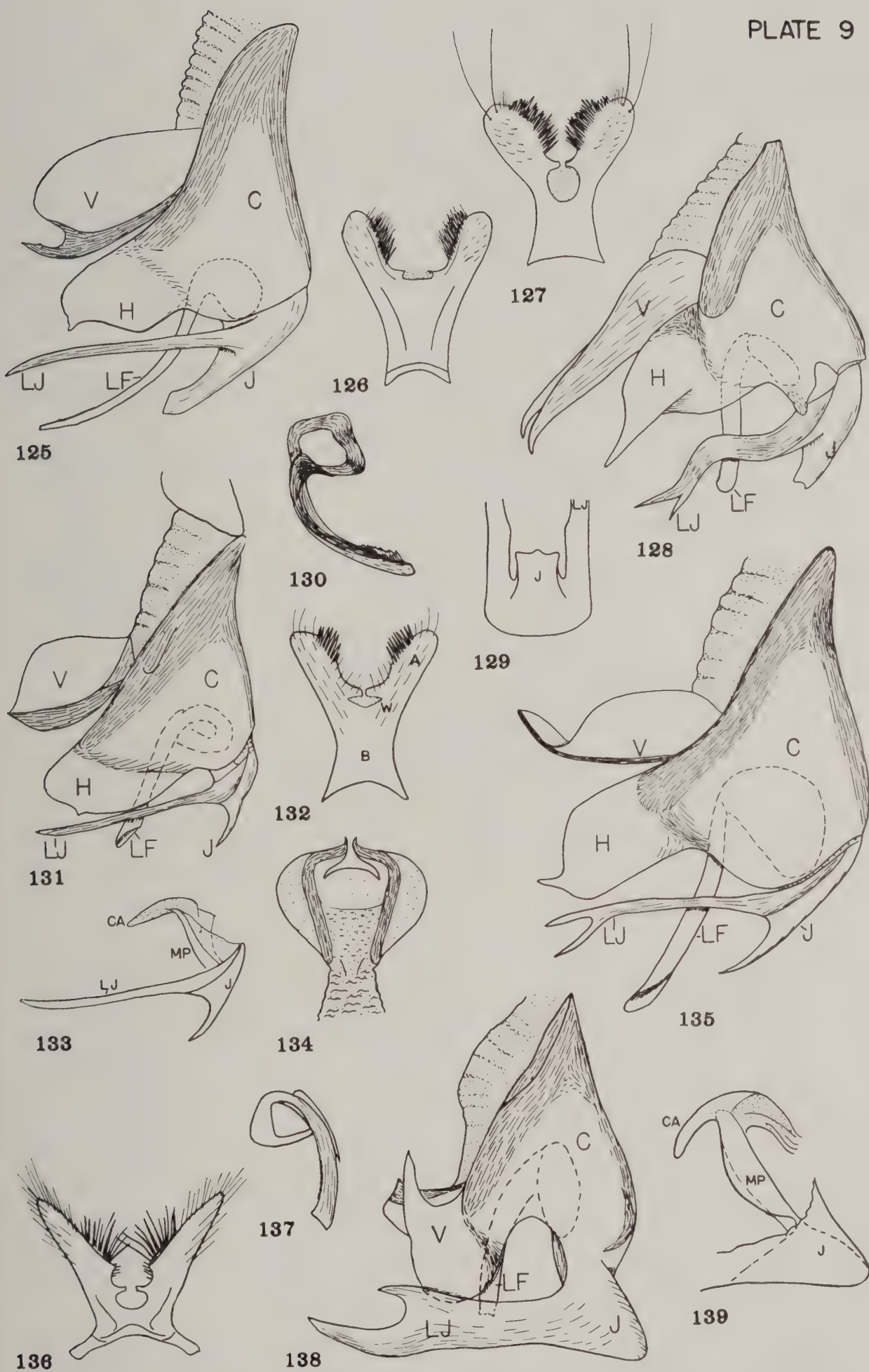


PLATE 10

*Sarcophaga argyrostoma* Robineau-Desvoidy

FIG. 140. Phallus, lateral view.

FIG. 141. Juxta, lateral juxtal process, median process and capitis, lateral view.

FIG. 142. Fifth sternite.

*Sarcophaga crassipalpis* Macquart

FIG. 143. Phallus, antero-dorsal view.

FIG. 144. Fifth sternite.

FIG. 145. Phallus, lateral view.

FIG. 146. Juxta, lateral juxtal process, median process and capitis, lateral view.

*Sarcophaga protuberans* Pandellé

FIG. 147. Capitis and median process, lateral view.

FIG. 148. Phallus, lateral view.

FIG. 149. Fifth sternite, base missing.

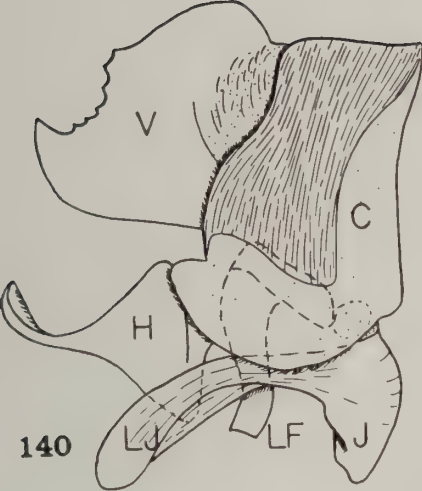
*Sarcophaga privigna* Rondani

FIG. 150. Fifth sternite.

FIG. 151. Capitis and median process, lateral view.

FIG. 152. Phallus, lateral view.





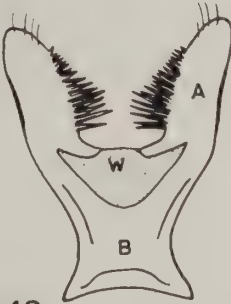
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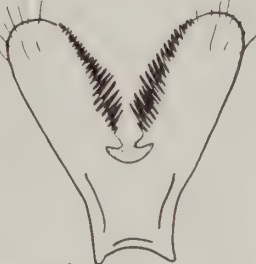
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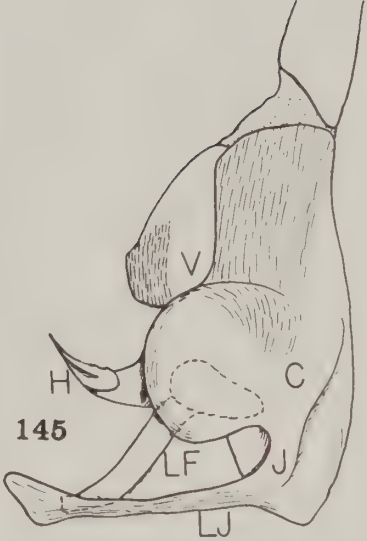
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142



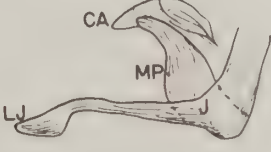
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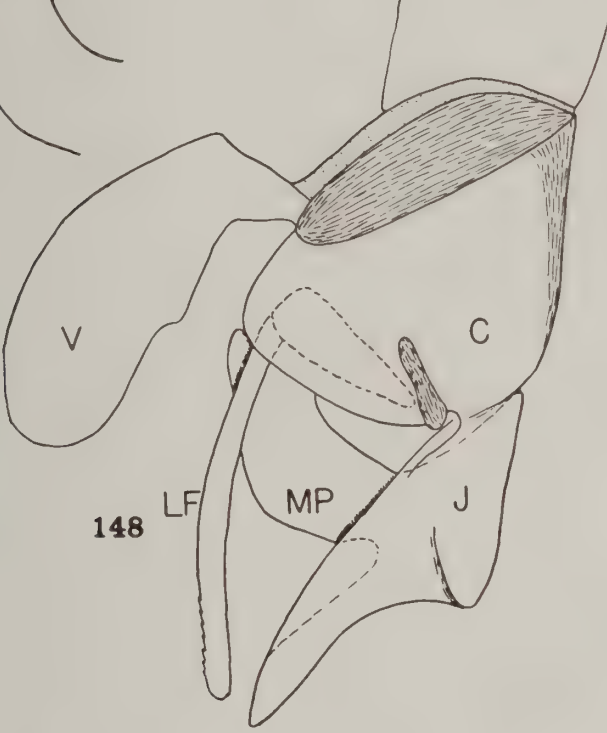
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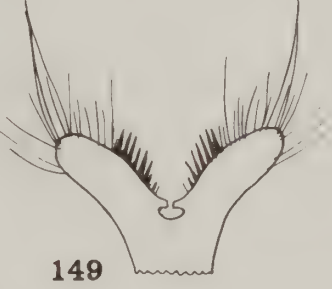
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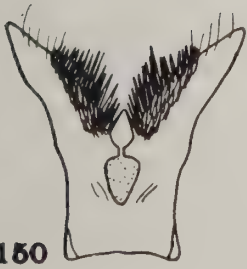
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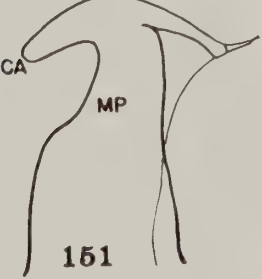
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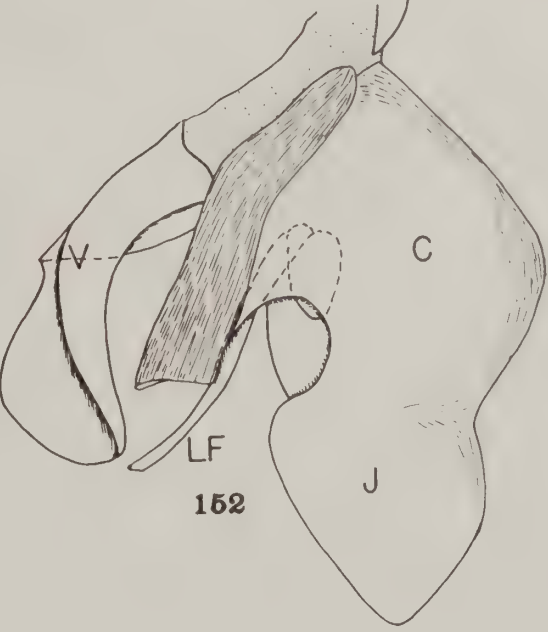
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151



152

PLATE 11

*Sarcophaga aratrix* Pandellé

FIG. 153. Phallus, lateral view.

FIG. 154. Fifth sternite.

FIG. 155. Capitis and median process, lateral view.

*Sarcophaga idonea* Aldrich

FIG. 156. Capitis, lateral view.

FIG. 157. Harpes, anterior view.

FIG. 158. Phallus, lateral view.

FIG. 159. Fifth sternite.

*Sarcophaga sima* Aldrich

FIG. 160. Juxta, median process and capitis, lateral view.

FIG. 161. Phallus, lateral view.

FIG. 162. Fifth sternite.

*Sarcophaga tarsata* Aldrich

FIG. 163. Juxta, median process and capitis, lateral view.

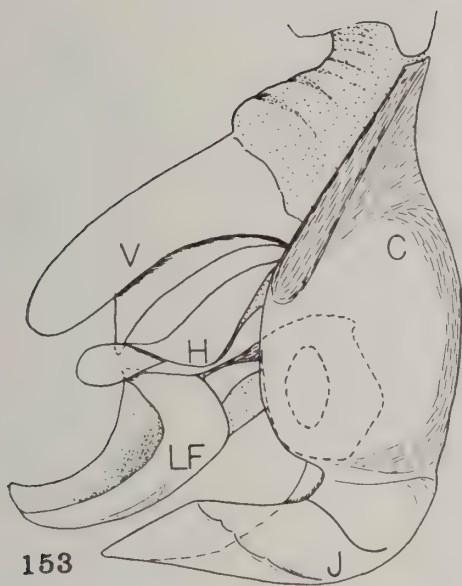
FIG. 164. Left lateral filament, anterior view.

FIG. 165. Phallus, anterior view, vesica removed.

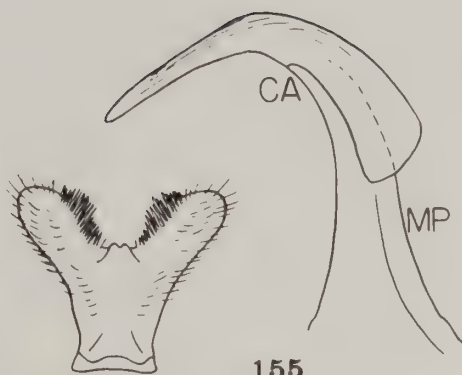
FIG. 166. Fifth sternite.

FIG. 167. Phallus, lateral view.



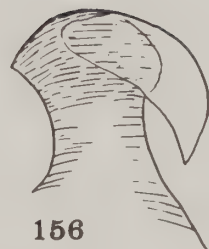


153

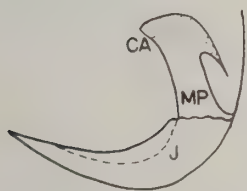


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155



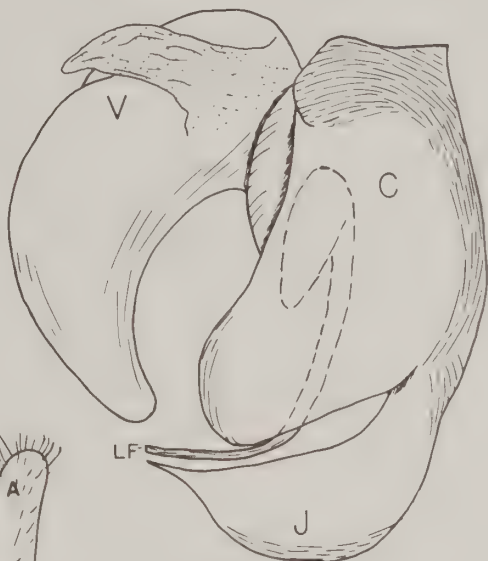
156



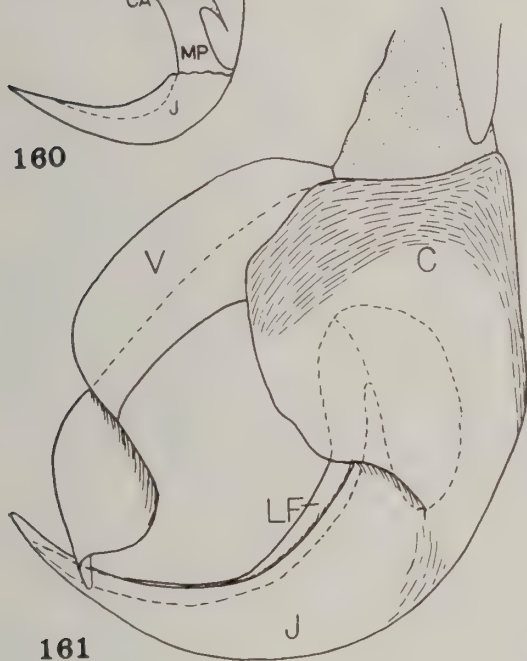
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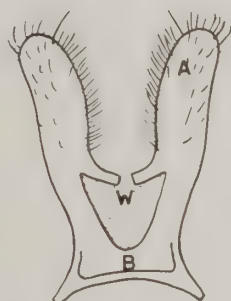
157



158



161



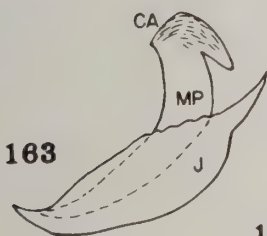
159



166



162



163



164



165



167

PLATE 12

*Sarcophaga parallela* Aldrich

- FIG. 168. Juxta, median process and capitis, lateral view.  
FIG. 169. Phallus, lateral view.  
FIG. 170. Fifth sternite.

*Sarcophaga sarraceniae* Riley

- FIG. 171. Fifth sternite.  
FIG. 172. Capitis, lateral view.  
FIG. 173. Phallus, lateral view.

*Sarcophaga soror* Rondani

- FIG. 174. Phallus, lateral view.  
FIG. 175. Harpes, anterior view.

*Sarcophaga tetra* Aldrich

- FIG. 176. Fifth sternite.  
FIG. 177. Phallus, lateral view.  
FIG. 178. Phallus, anterior view.

*Sarcophaga nigriventris* Meigen

- FIG. 178. 1. Fifth sternite.  
FIG. 178. 2. Phallus, lateral view.  
FIG. 178. 3. Phallus, anterior view—vesica removed.

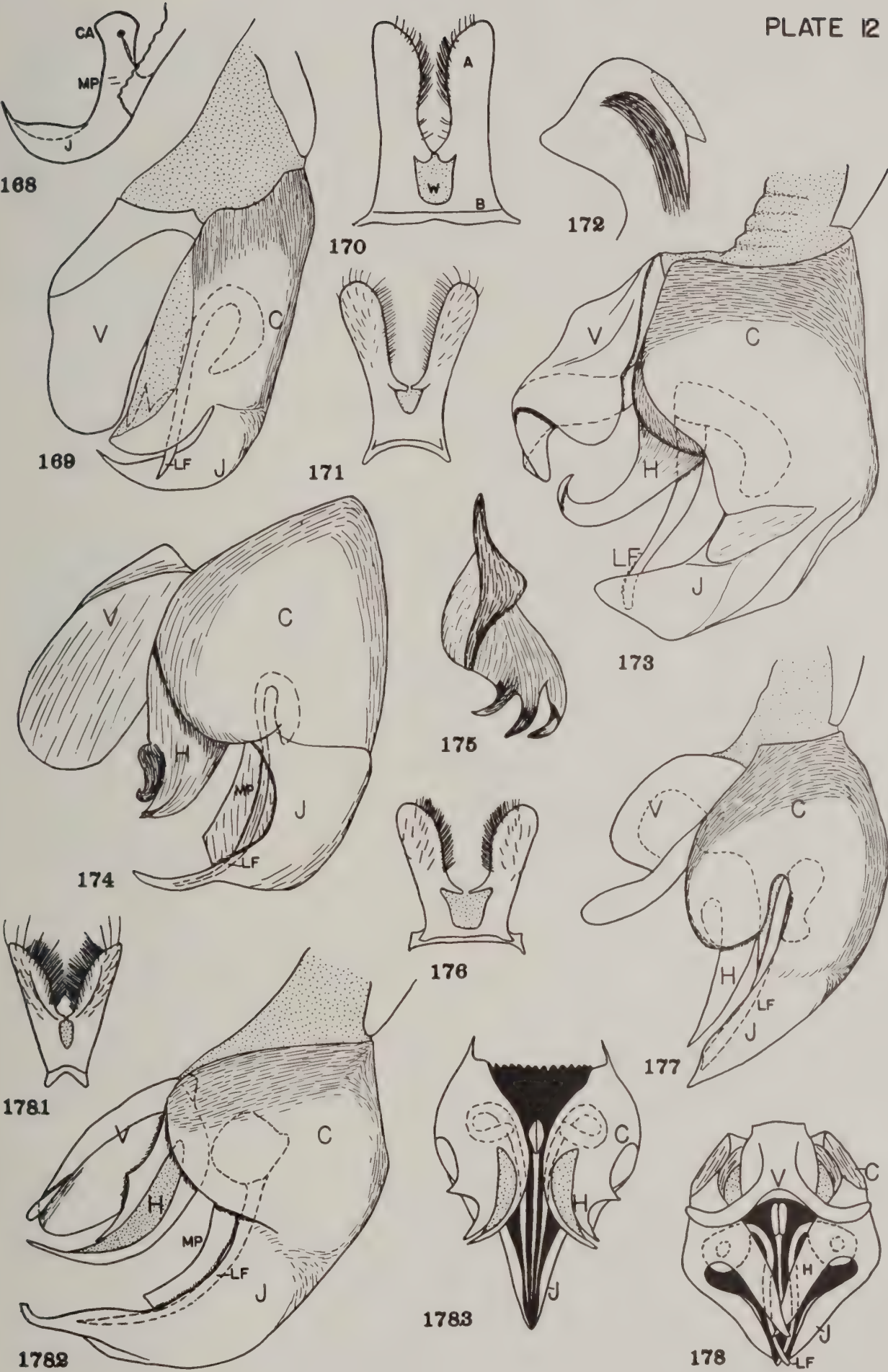




PLATE 13

*Sarcophaga incisilobata* Pandellé

FIG. 179. Phallus, lateral view.

FIG. 180. Juxta, ventral view.

FIG. 181. Fifth sternite.

*Sarcophaga pulla* Aldrich

FIG. 182. Fifth sternite.

FIG. 183. Phallus, lateral view.

FIG. 184. Capitis and median process, lateral view.

FIG. 185. Harpes, anterior view.

*Sarcophaga occidentalis* Aldrich

FIG. 186. Phallus, anterior view.

FIG. 187. Juxta, median process and capitis, lateral view.

FIG. 188. Left lateral filament, antero-lateral view.

FIG. 189. Harpes, anterior view.

FIG. 190. Fifth sternite.

*Sarcophaga fulvipes* Macquart

FIG. 191. Phallus, lateral view.

FIG. 192. Left lateral filament, ventral view.

FIG. 193. Fifth sternite.

FIG. 194. Capitis and median process, lateral view.

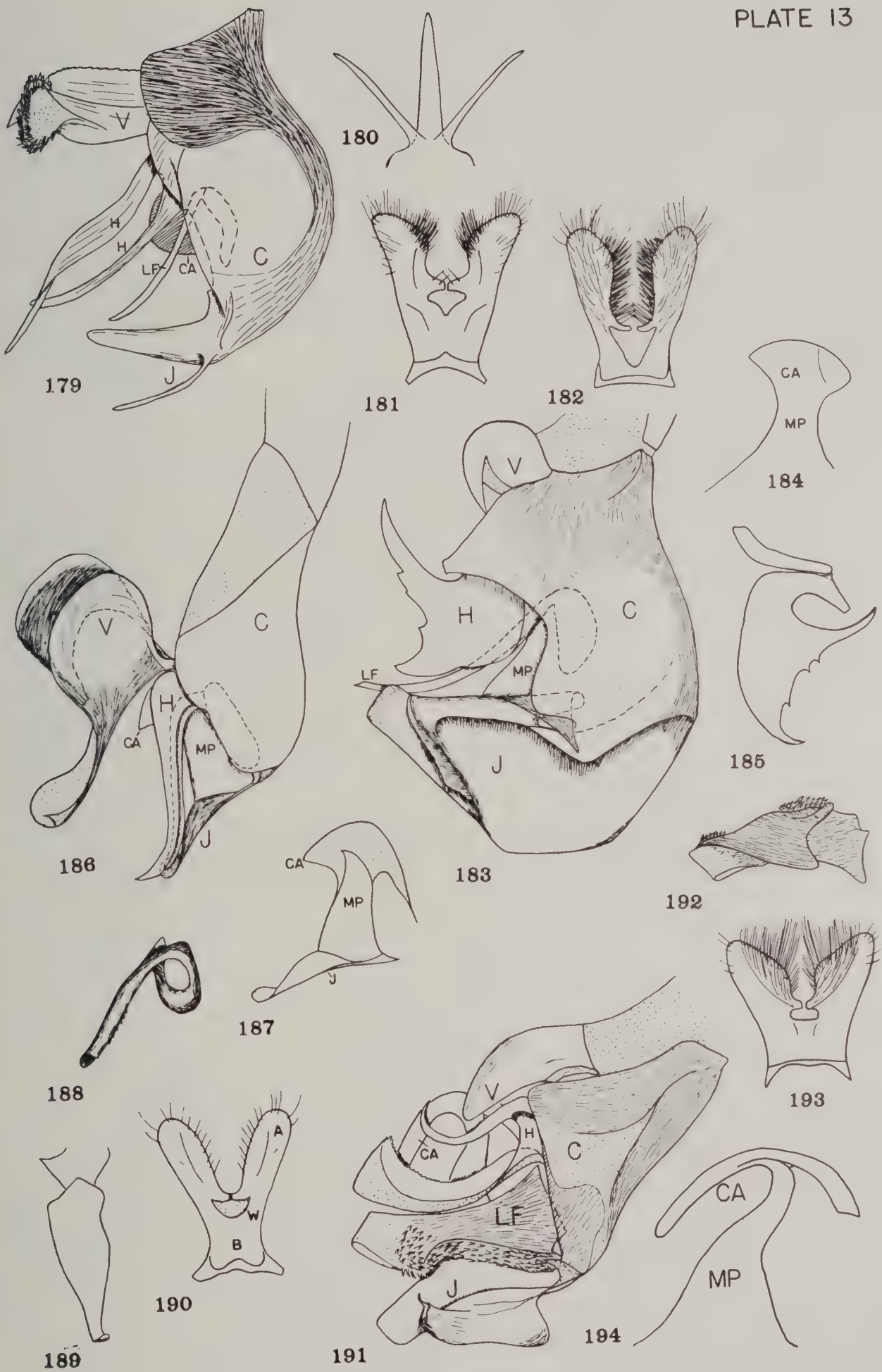


PLATE 14

*Sarcophaga carnaria* (Linnaeus)

- FIG. 195. Phallus, lateral view.  
FIG. 196. Juxta of another specimen.  
FIG. 197. Left lateral filament, meso-ventral view.  
FIG. 198. Juxta, median process and capitis, lateral view.  
FIG. 199. Phallus, anterior view—vesica removed.  
FIG. 200. Fifth sternite.

*Sarcophaga thatuna* Aldrich

- FIG. 201. Phallus, lateral view.  
FIG. 202. Fifth sternite.

*Sarcophaga juliaetta* Aldrich

- FIG. 203. Phallus, lateral view.  
FIG. 204. Fifth sternite.

*Sarcophaga gracilis* Aldrich

- FIG. 205. Fifth sternite.  
FIG. 206. Vesica, dorsal view.  
FIG. 207. Juxta, median process and capitis, lateral view.  
FIG. 208. Phallus, lateral view.



PLATE 14

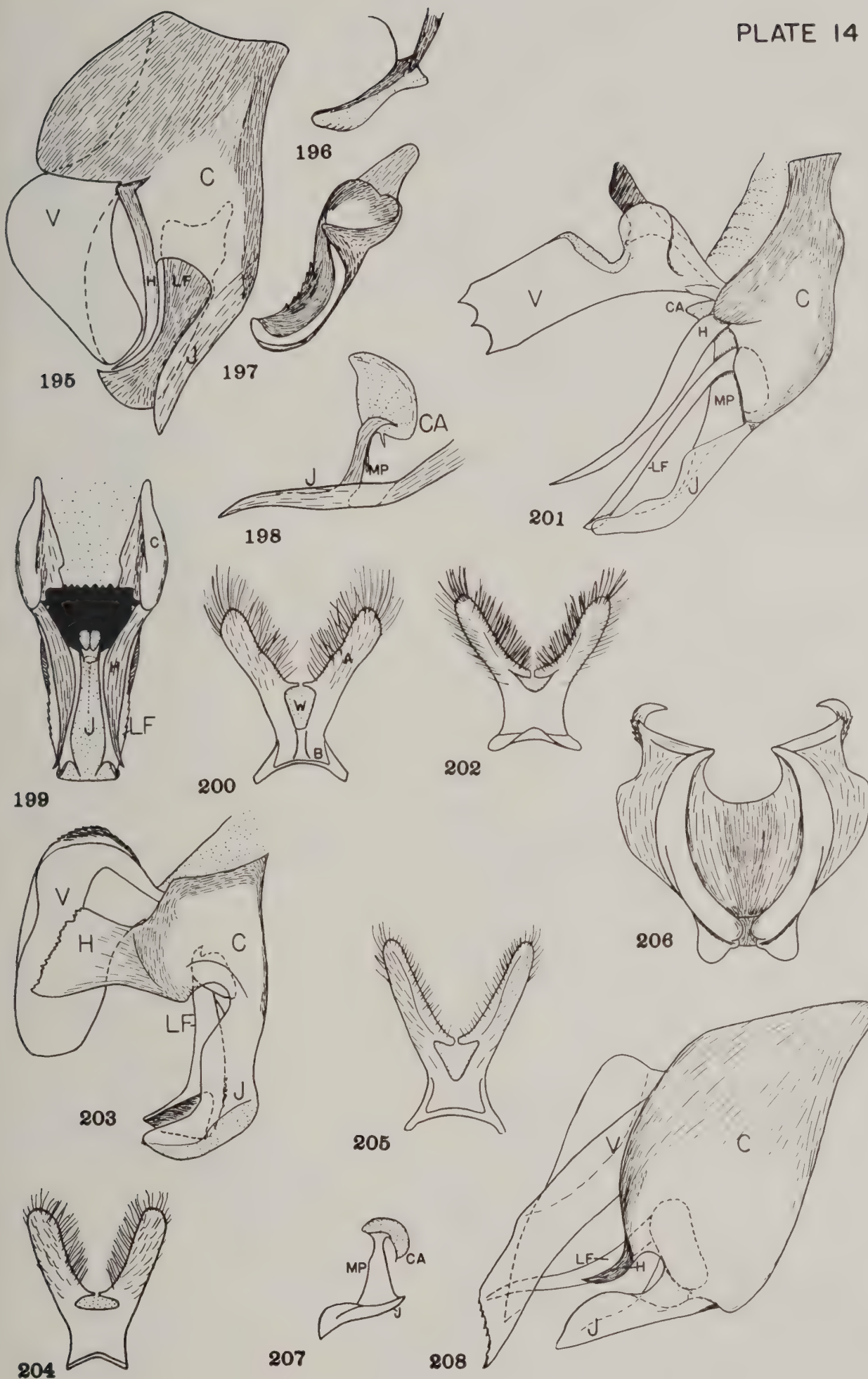


PLATE 15

*Sarcophaga haemorrhoidalis* (Fallén)

FIG. 209. Tip of phallus, lateral view.

FIG. 210. Tip of phallus, anterior view.

FIG. 211. Juxta, median process and capitis, lateral view.

FIG. 212. Fifth sternite.

*Sarcophaga piva* Roback

FIG. 213. Phallus, lateral view.

FIG. 214. Fifth sternite.

*Ravinia stimulans* (Walker)

FIG. 215. Phallus, caudal view.

FIG. 216. Median process and dorsal rod, antero-lateral view.

FIG. 217. Phallus, lateral view.

FIG. 218. Fifth sternite.

FIG. 219. Phallus, anterior view—hilae removed.

*Ravinia laakei* (Hall)

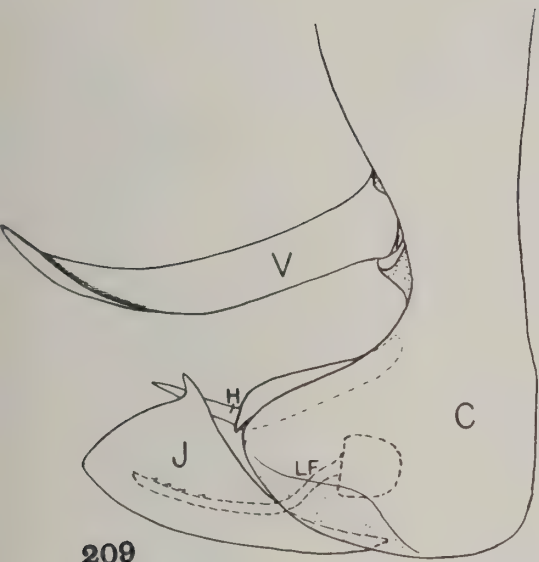
FIG. 220. Phallus, lateral view.

FIG. 221. Vesica, dorsal view.

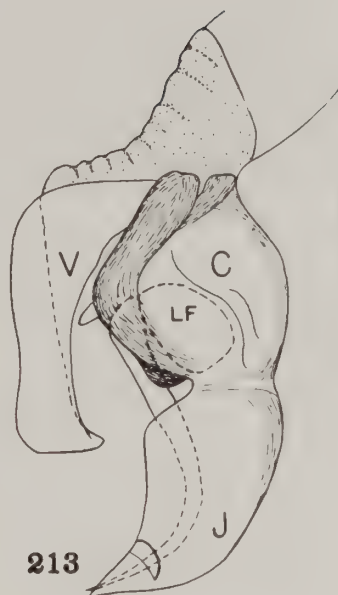
FIG. 222. Median process and dorsal rod, antero-lateral view.

FIG. 223. Median process, antero-dorsal view.

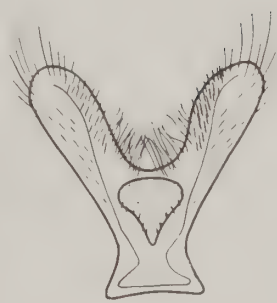
FIG. 224. Fifth sternite.



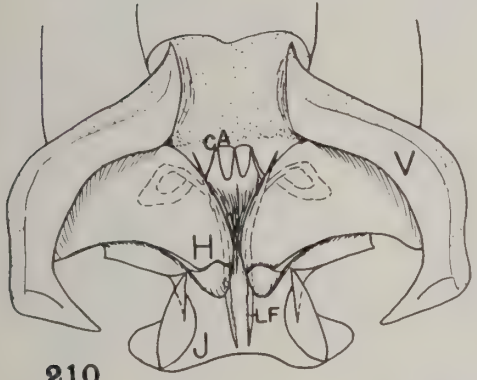
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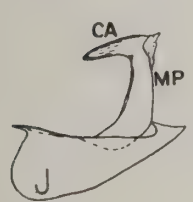
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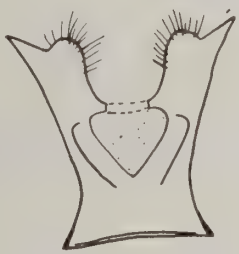
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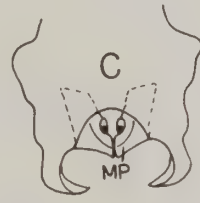
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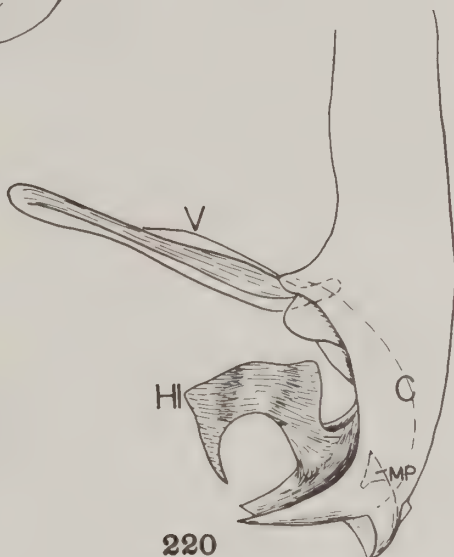
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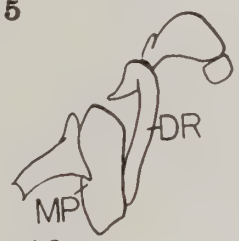
212



215



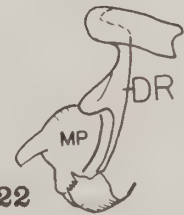
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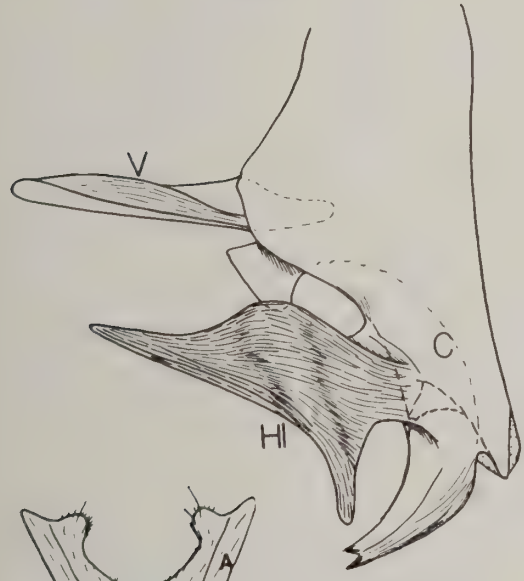
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221



222



217



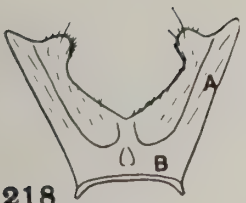
219



223



224



218



PLATE 16

*Ravinia latisetosa* Parker

FIG. 225. Fifth sternite.

FIG. 226. Phallus, lateral view.

*Ravinia effrenata* (Walker)

FIG. 227. Juxta and associated structures, antero-dorsal view.

FIG. 228. Fifth sternite.

FIG. 229. Phallus, lateral view.

*Ravinia errabunda* (Van der Wulp)

FIG. 230. Fifth sternite.

FIG. 231. Phallus, lateral view.

FIG. 232. Internal structures of phallus, anterior view—vesica and most of corpus removed.

*Ravinia aurigena* (Townsend)

FIG. 233. Phallus, lateral view.

FIG. 234. Fifth sternite.

*Ravinia floridensis* (Aldrich)

FIG. 235. Fifth sternite.

FIG. 236. Phallus, lateral view.

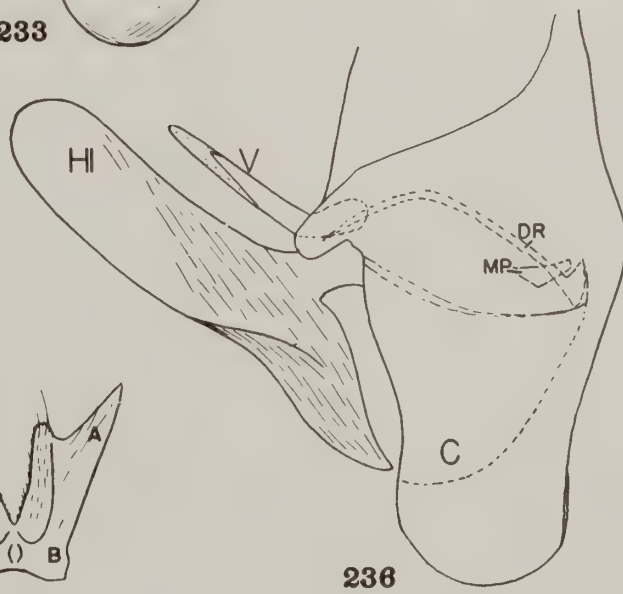
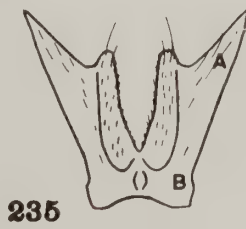
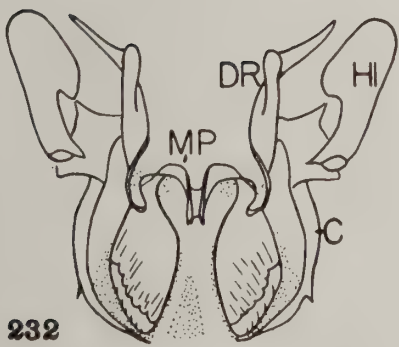
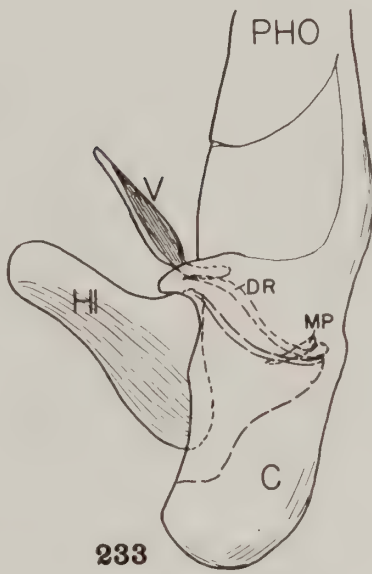
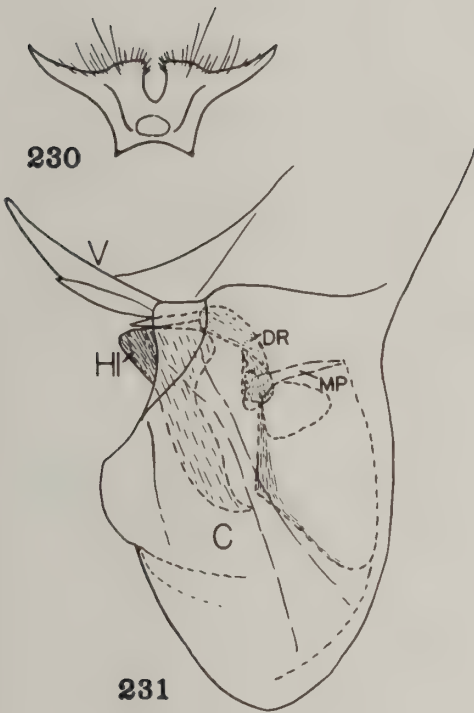
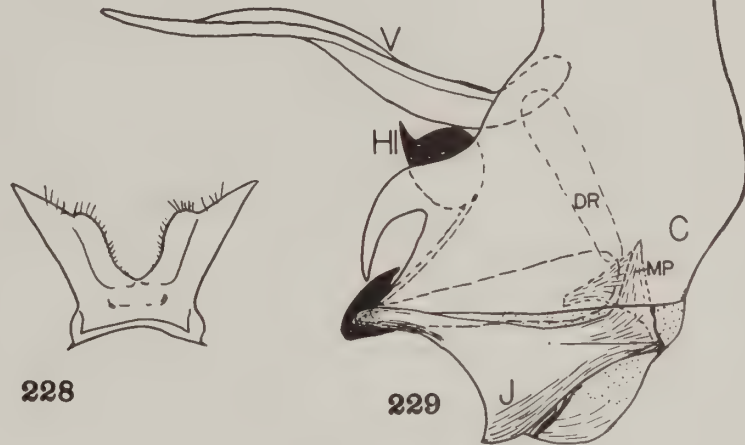
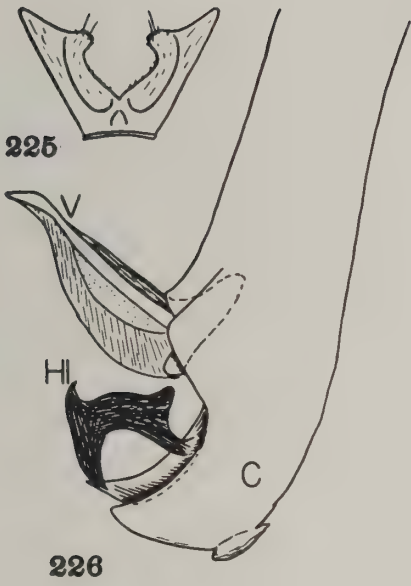


PLATE 17

*Ravinia sueta* (Van der Wulp)

FIG. 237. Phallus, lateral view.

FIG. 238. Dorsal rod, median process, lateral view.

FIG. 239. Fifth sternite.

*Ravinia querula* (Walker)

FIG. 240. Phallus, lateral view.

FIG. 241. Fifth sternite.

*Ravinia l'herminieri* (Robineau-Desvoidy)

FIG. 242. Fifth sternite.

FIG. 243. Phallus, lateral view.

FIG. 244. Phallus, antero-ventral view—hillae removed.

*Ravinia planifrons* (Aldrich)

FIG. 245. Fifth sternite.

FIG. 246. Phallus, lateral view.

*Ravinia pectinata* (Aldrich)

FIG. 247. Phallus, ventral view.

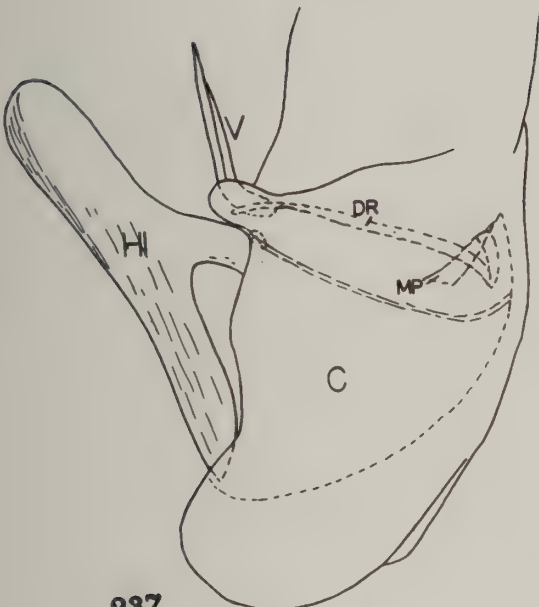
FIG. 248. Fifth sternite.

FIG. 249. Phallus, lateral view.

FIG. 250. Vesica, dorsal rods and median process, lateral view in natural relationship.



PLATE 17



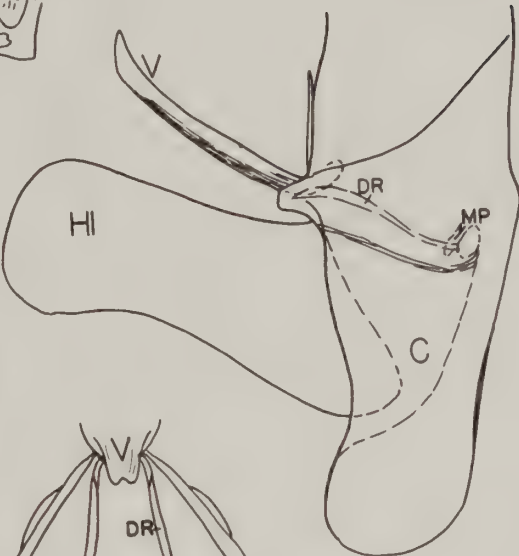
237



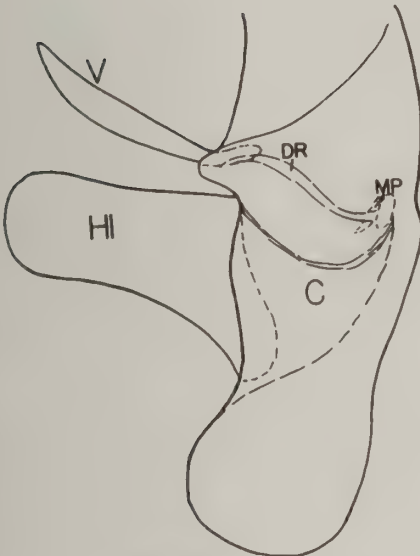
238



239



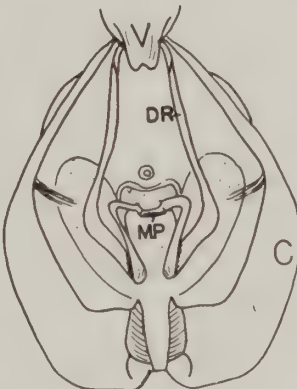
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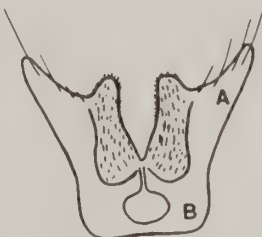
240



242



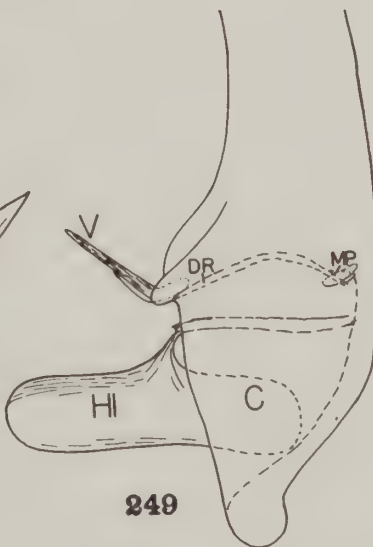
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241



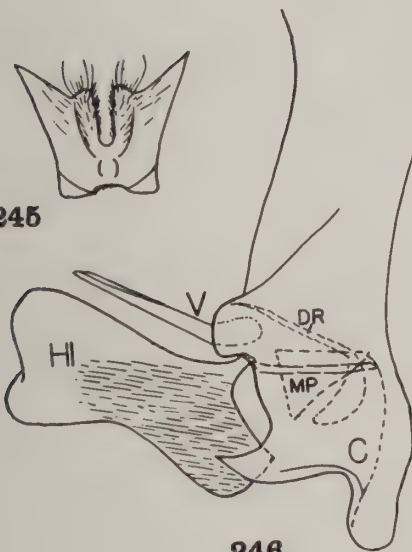
248



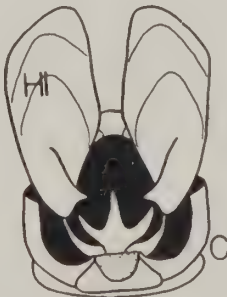
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247



250

PLATE 18

*Ravinia pusiola* (Van der Wulp)

FIG. 251. Fifth sternite.

FIG. 252. Phallus, lateral view.

FIG. 253. Phallus, antero-ventral view—hillae removed.

*Ravinia tancituro* Roback

FIG. 254. Fifth sternite.

FIG. 255. Phallus, lateral view.

*Oxysarcodexia galeata* (Aldrich)

FIG. 256. Fifth sternite.

FIG. 257. Phallus, lateral view.

FIG. 258. Median process and lateral filament, lateral view.

FIG. 259. Median process and lateral filaments, dorsal view.

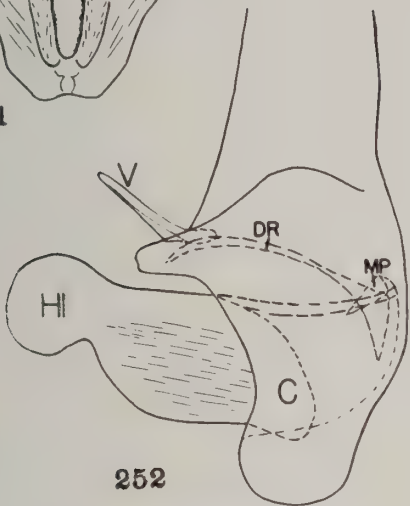
*Oxysarcodexia xanthosoma* (Aldrich)

FIG. 260. Tip of phallus, antero-dorsal view—vesica removed.

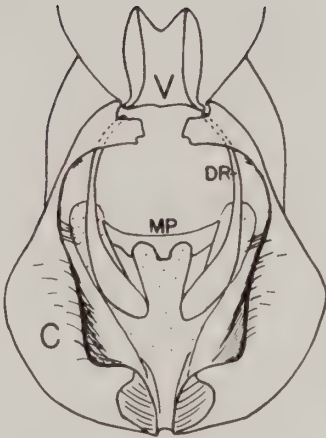
FIG. 261. Phallus, lateral view.



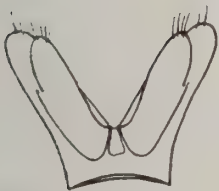
251



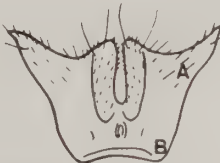
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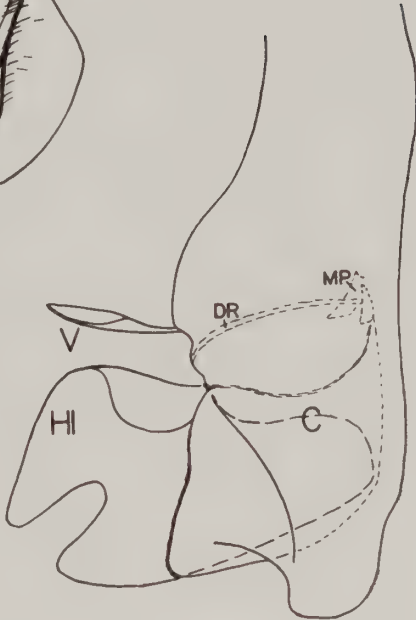
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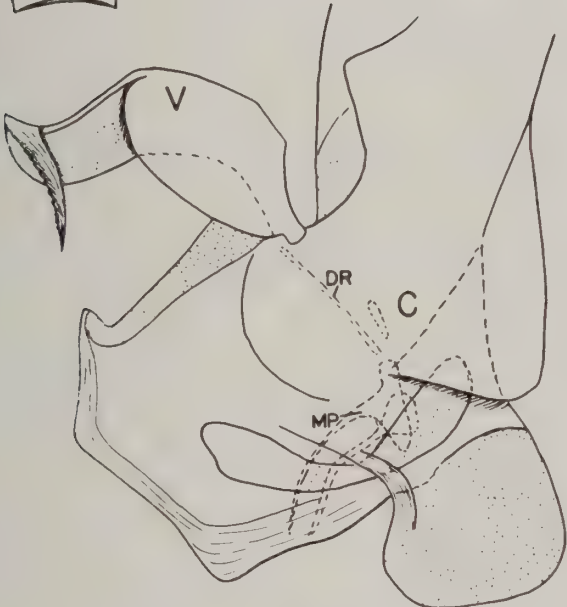
256



254



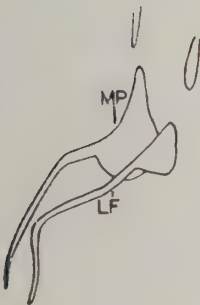
255



257



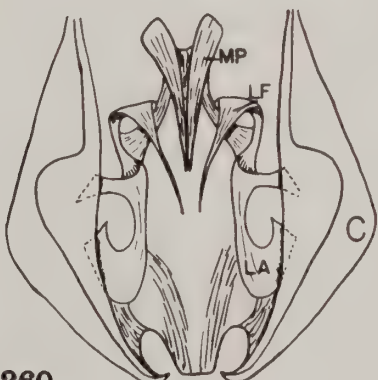
261



258



259



260



PLATE 19

*Oxysarcodexia peltata* (Aldrich)

FIG. 262. Phallus, lateral view.

FIG. 263. Fifth sternite.

*Oxysarcodexia ochripyga* (Van der Wulp)

FIG. 264. Phallus, lateral view.

FIG. 265. Fifth sternite.

FIG. 266. Median process, lateral filaments and arms, dorsal view.

FIG. 267. Median process and dorsal rods, lateral view.

*Oxysarcodexia ventricosa* (Van der Wulp)

FIG. 268. Lateral arm and filament, antero-meso-dorsal view—showing attachment of lateral arm to wall of corpus.

FIG. 269. Phallus, lateral view.

FIG. 270. Dorsal rods, median process, lateral arms and filaments, dorsal view.

FIG. 271. Fifth sternite.

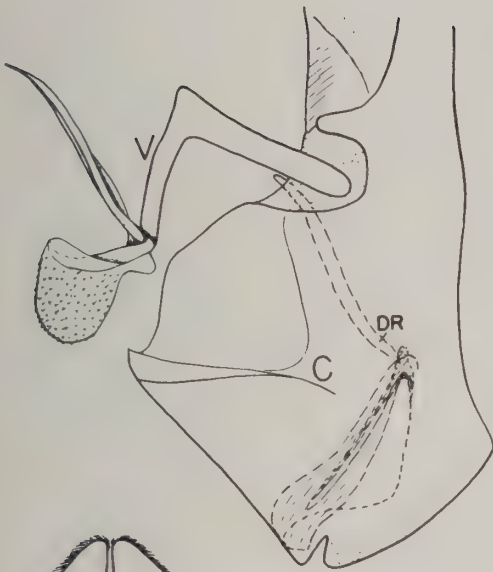
*Oxysarcodexia trivialis* (Van der Wulp)

FIG. 272. Fifth sternite.

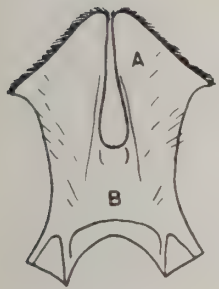
FIG. 273. Phallus, antero-ventral view.

FIG. 274. Phallus, lateral view.

PLATE 19



262



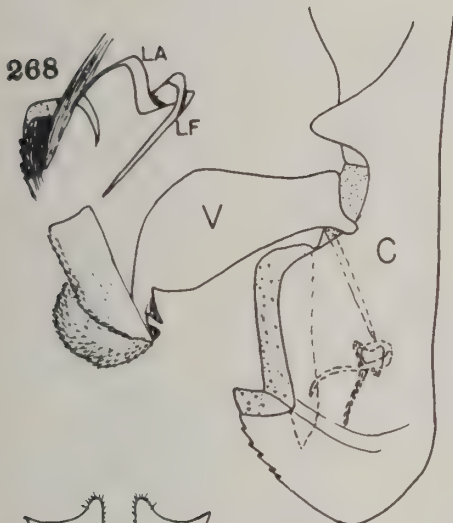
263



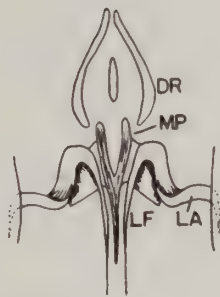
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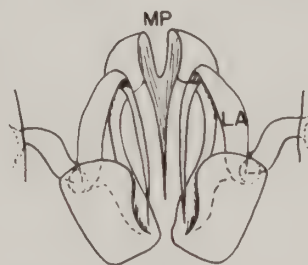
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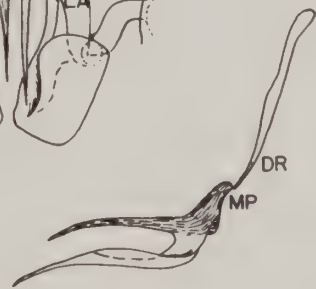
268



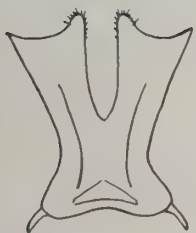
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266



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269



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PLATE 20

*Oxysarcodexia cingarus* (Aldrich)

FIG. 275. Fifth sternite.

FIG. 276. Phallus, lateral view.

FIG. 277. Median process and lateral filament, lateral view.

*Oxysarcodexia bakeri* (Aldrich)

FIG. 278. Median process, lateral filament and lateral arm, lateral view.

FIG. 279. Fifth sternite.

FIG. 280. Aedeagus, lateral view.

*Hystericocnema plinthopyga* (Wiedemann)

FIG. 281. Phallus, lateral view.

FIG. 282. Fifth sternite.

FIG. 283. Tip of phallus, antero-dorsal view.

FIG. 284. Left lateral filament, antero-ventral view.

*Cistudinomyia cistudinis* (Aldrich)

FIG. 285. Tip of phallus, antero-dorsal view—vesica removed.

FIG. 286. Phallus, lateral view.

FIG. 287. Fifth sternite.

*Paraphrissopoda gulo* (Fabricius)

FIG. 288. Fifth sternite.

FIG. 289. Phallus, lateral view.



# PLATE 20

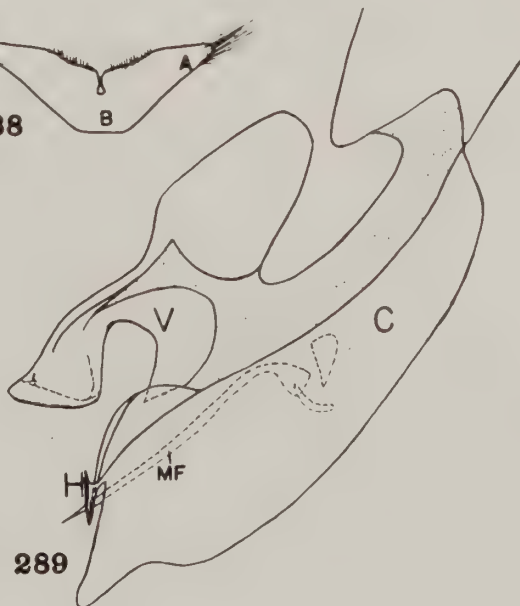
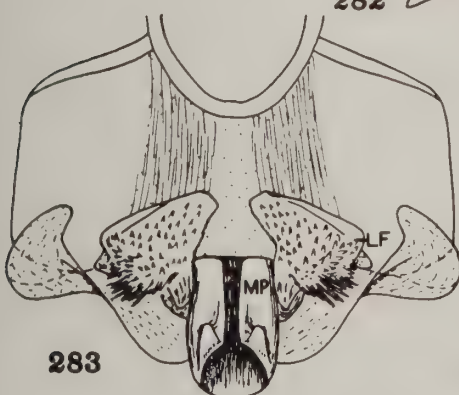
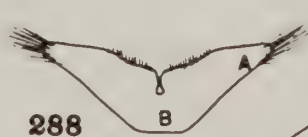
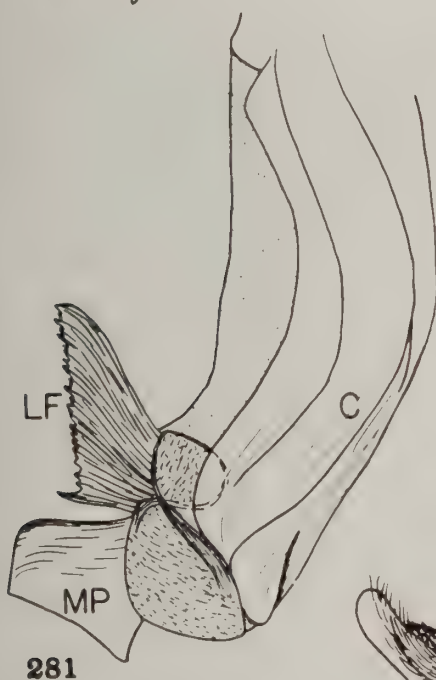
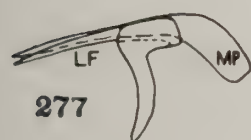
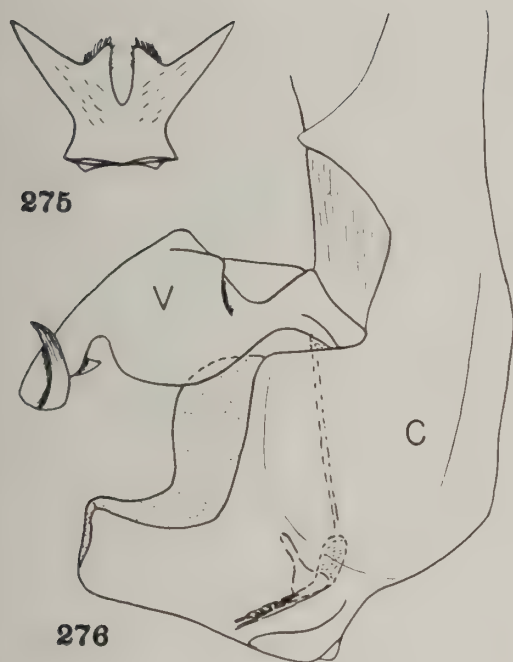


PLATE 21

*Paraphrissopoda chrysostoma* (Wiedemann)

FIG. 290. Phallus, lateral view.

FIG. 291. Vesica and harpes, dorsal view.

FIG. 292. Fifth sternite.

*Paraphrissopoda capitata* (Aldrich)

FIG. 293. Tip of phallus, antero-ventral view—vesica removed.

FIG. 294. Phallus, lateral view.

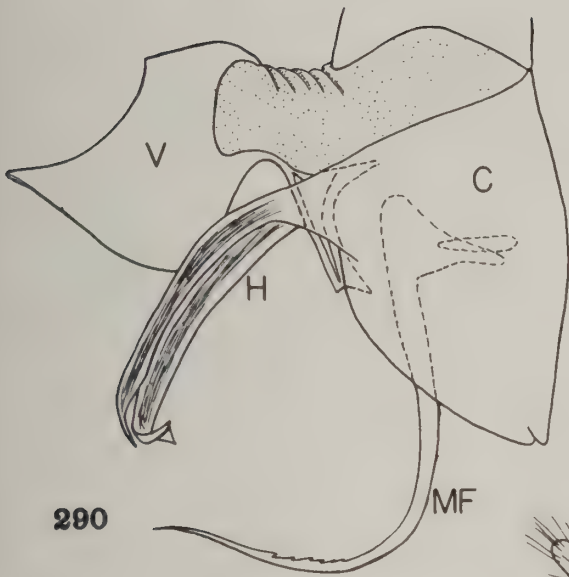
FIG. 295. Fifth sternite.

*Paraphrissopoda amoena* (Aldrich)

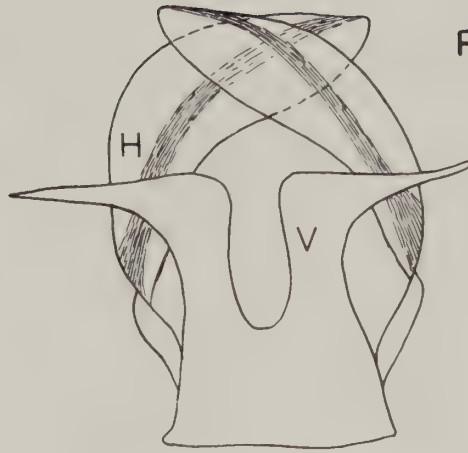
FIG. 296. Fifth sternite.

FIG. 297. Phallus, lateral view.

FIG. 298. Tip of phallus, antero-dorsal view—vesica removed.



290



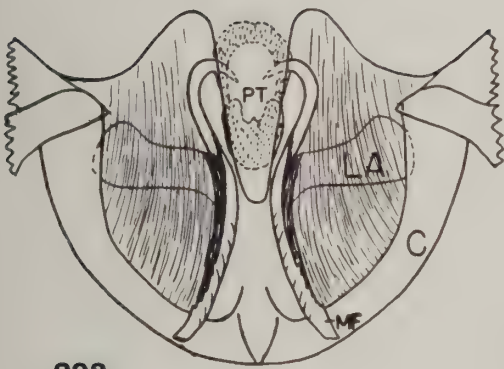
291



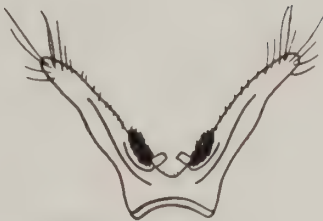
292



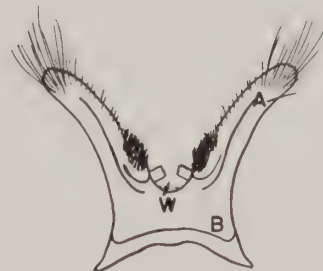
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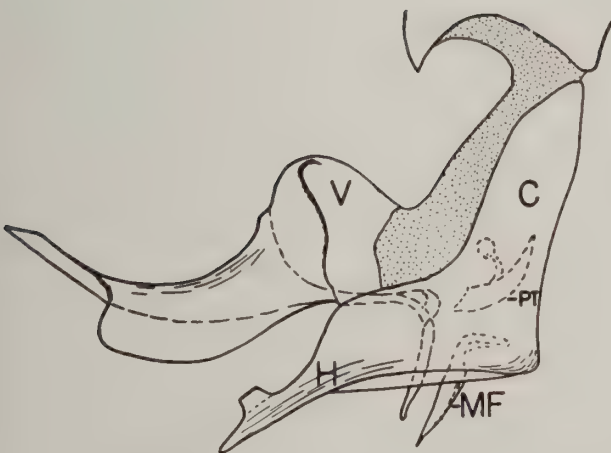
293



296



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297



298



PLATE 22

*Paraphrissopoda hillifera* (Aldrich)

FIG. 299. Phallus, lateral view.

FIG. 300. Phallus, antero-ventral view.

FIG. 301. Fifth sternite.

*Sarcodexia lambens* (Wiedemann)

FIG. 302. Phallus, anterior view.

FIG. 303. Fifth sternite.

FIG. 304. Phallus, lateral view.

*Euboettcheria australis* Townsend

FIG. 305. Base of phallus, anterior view.

FIG. 306. Fifth sternite.

FIG. 307. Phallus, lateral view.

*Kellymyia kellyi* (Aldrich)

FIG. 308. Fifth sternite.

FIG. 309. Aedeagus, lateral view.

PLATE 22

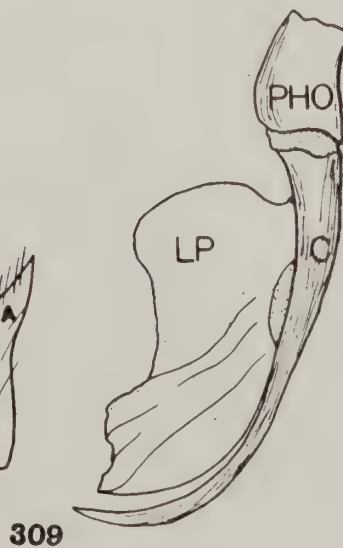
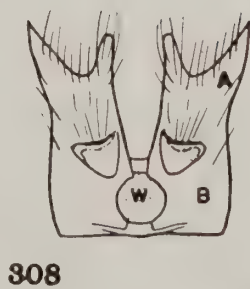
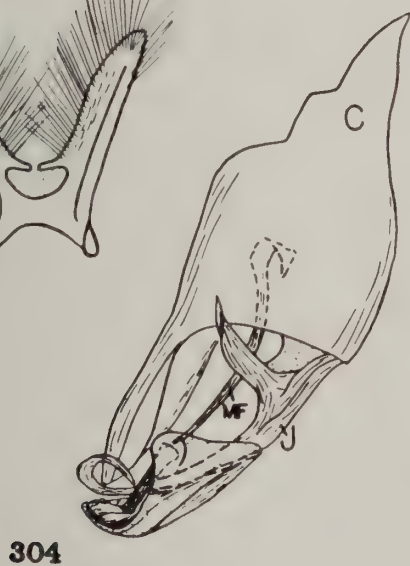
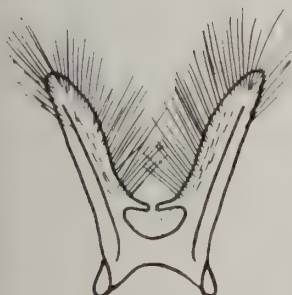
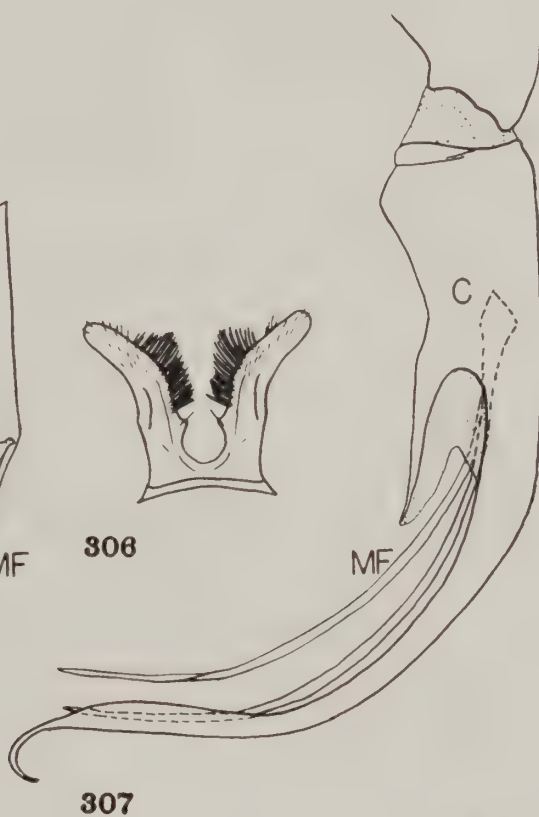
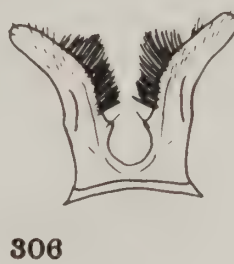
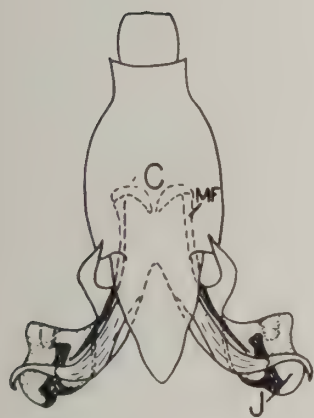
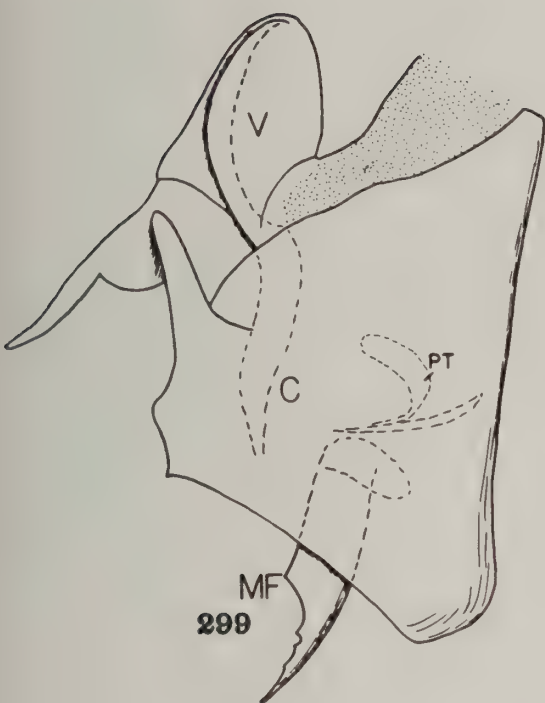


PLATE 23

*Rafaelia rufiventris* Townsend

FIG. 310. Phallus, lateral view.

FIG. 311. Phallus, anterior view.

FIG. 312. Fifth sternite.

*Rafaelia ampulla* (Aldrich)

FIG. 313. Phallus, lateral view.

FIG. 314. Tip of phallus, antero-dorsal view.

FIG. 315. Fifth sternite, dotted section missing in specimen.

*Metoposarcophaga* (*Zygastropyga*) *sulculata* (Aldrich)

FIG. 316. Aedeagus, lateral view.

FIG. 317. Phallus, ventral view.

FIG. 318. Median process, lateral view.

FIG. 319. Median process and lateral filaments, dorsal view.

FIG. 320. Fifth sternite.

*Metoposarcophaga* (*Metoposarcophaga*) *importuna* (Walker)

FIG. 321. Fifth sternite.

FIG. 322. Median process, lateral view.

FIG. 323. Lateral filament, lateral view.

FIG. 324. Aedeagus, lateral view.

*Metoposarcophaga* (*Zygastropyga*) *villipes* (Van der Wulp)

FIG. 325. Fifth sternite.

FIG. 326. Aedeagus, lateral view.



PLATE 23

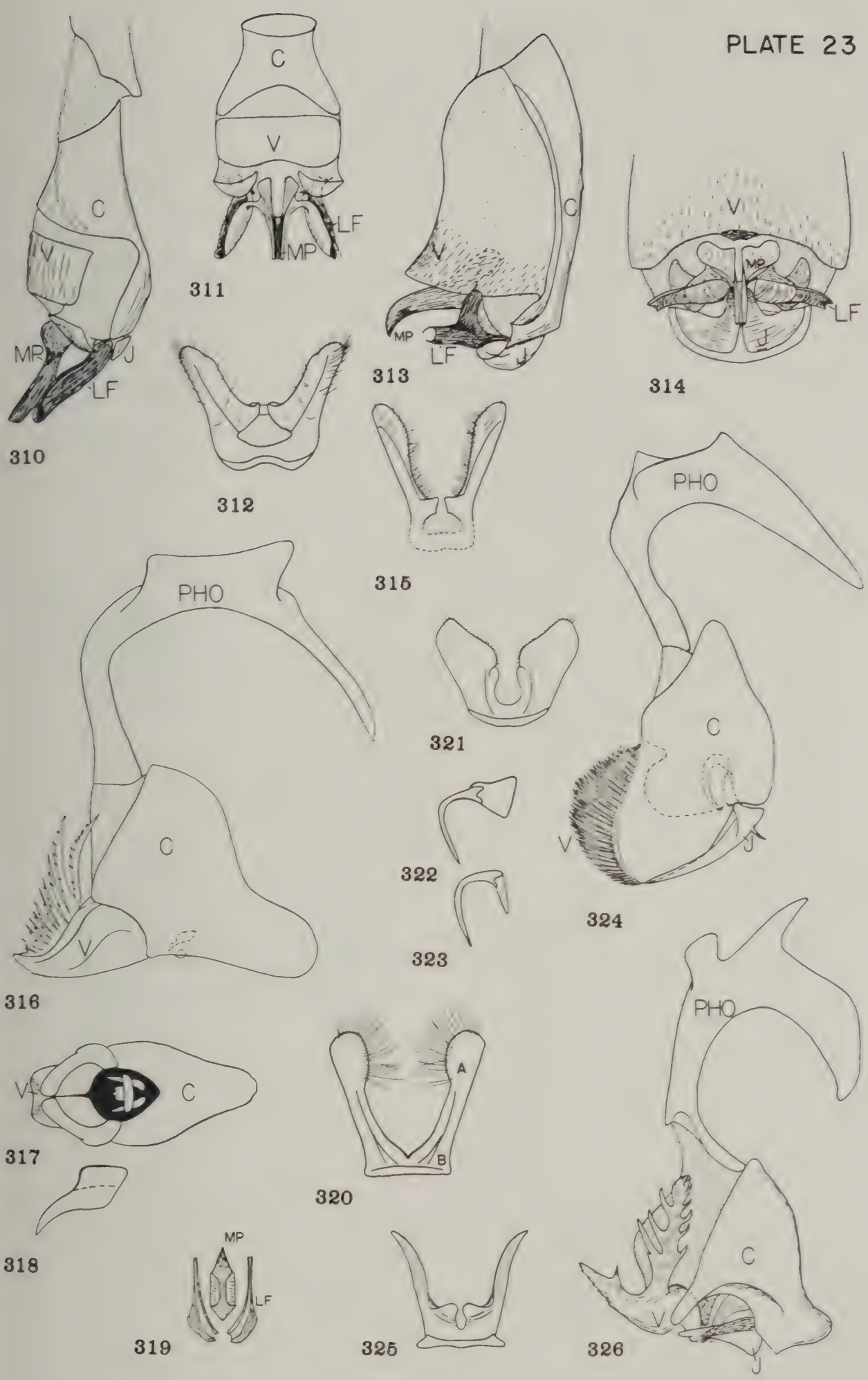


PLATE 24

*Metoposarcophaga (Zygastropyga) aurea* (Townsend)

FIG. 327. Aedeagus, lateral view.

FIG. 328. Fifth sternite.

FIG. 329. Phallus, ventral view.

*Aphelomyia welchi* (Hall)

FIG. 330. Phallus, lateral view.

FIG. 331. Phallus, antero-ventral view.

FIG. 332. Fifth sternite.

*Metoposarcophaga (Zygastropyga) cantenea* (Roback)

FIG. 333. Genitalia, lateral view.

FIG. 334. Anal plates and forceps, caudal view.

FIG. 335. Aedeagus, lateral view.

FIG. 336. Phallus, ventral view.

PLATE 24

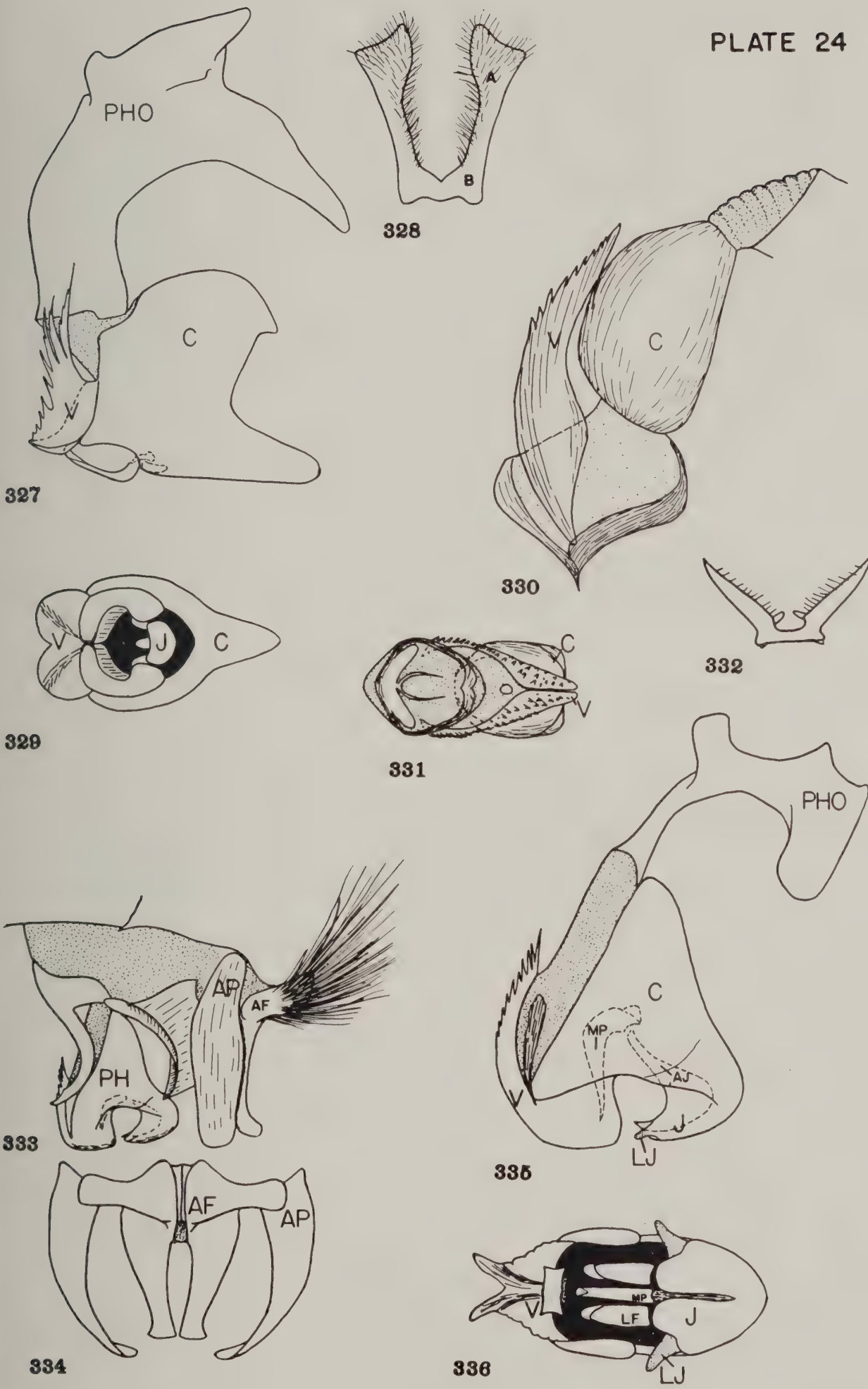




PLATE 25

*Boettcheria cimbicis* (Townsend)

FIG. 337. Phallus, lateral view.

FIG. 338. Fifth sternite.

FIG. 339. Vesica, anterior view—membranous parts removed.

FIG. 340. Juxta and median process, lateral view.

*Boettcheria bisetosa* Parker

FIG. 341. Phallus, lateral view.

FIG. 342. Juxta, anterior juxtal process and median process, lateral view.

FIG. 343. Right lateral filament, lateral view.

*Boettcheria carata* Roback

FIG. 344. Fifth sternite.

FIG. 345. Phallus, lateral view.

*Boettcheria latisterna* Parker

FIG. 346. Phallus, lateral view.

FIG. 347. Fifth sternite.

FIG. 348. Vesica, anterior view.

FIG. 349. Juxta, anterior juxtal process and median process, lateral view.

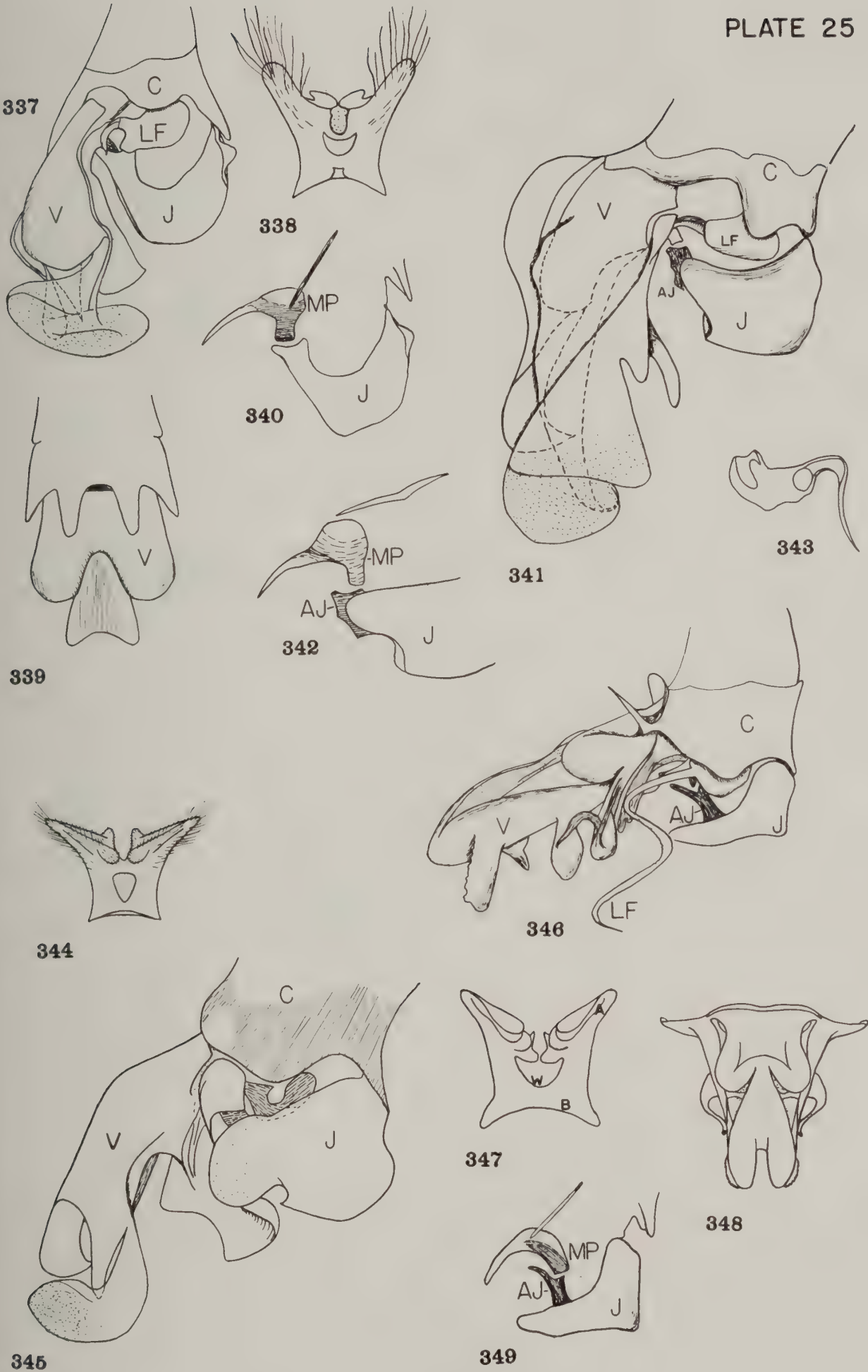


PLATE 26

*Spirobolomyia pallipes* (Walker)

FIG. 350. Phallus, lateral view—left lateral plate removed.

FIG. 351. Fifth sternite.

*Spirobolomyia flavipes* (Aldrich)

FIG. 352. Phallus, lateral view.

FIG. 353. Corpus, caudal view.

FIG. 354. Fifth sternite.

FIG. 355. Lateral filaments, median process and juxta, lateral view in natural relationship.

*Cucullomyia texana* (Aldrich)

FIG. 356. Fifth sternite.

FIG. 357. Phallus, lateral view.

FIG. 358. Juxta and base of median process, lateral view.

FIG. 359. Phallus, antero-dorsal view.

*Spirobolomyia basalis* (Walker)

FIG. 360. Phallus, lateral view.

FIG. 361. Fifth sternite.



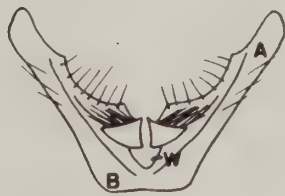
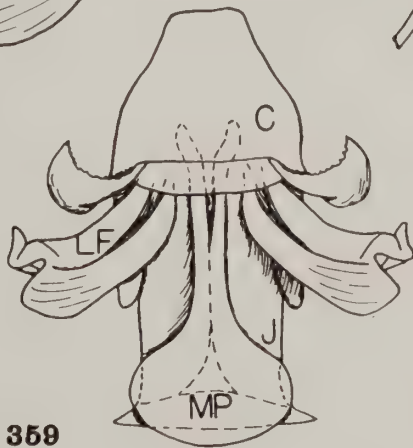
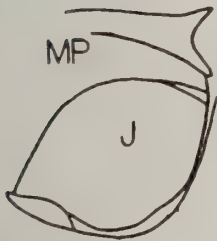
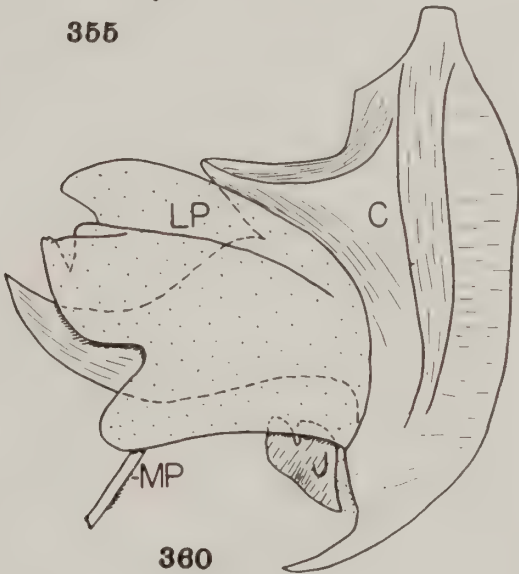
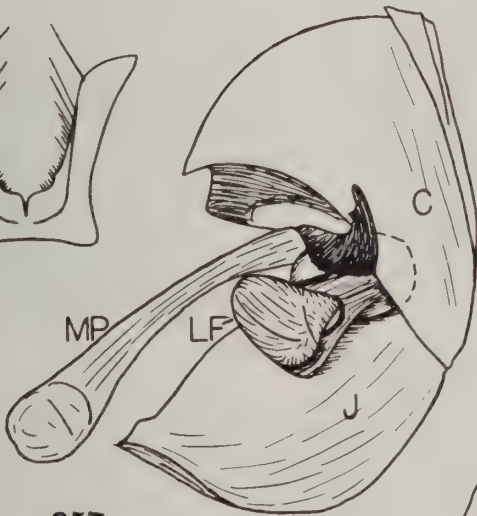
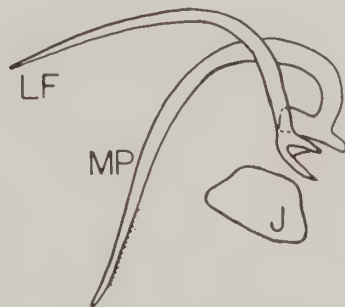
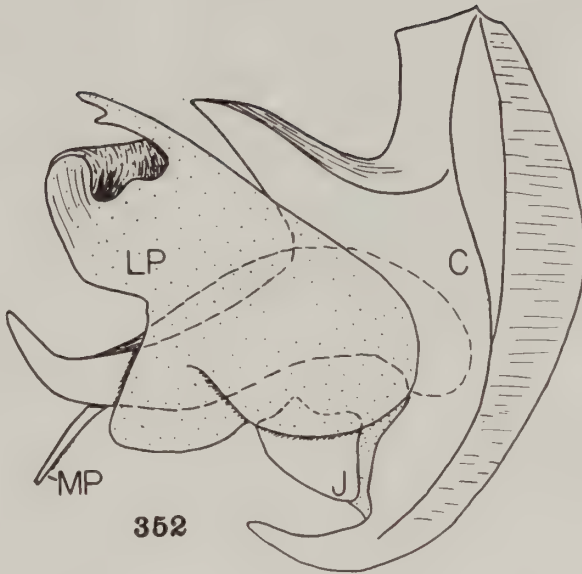
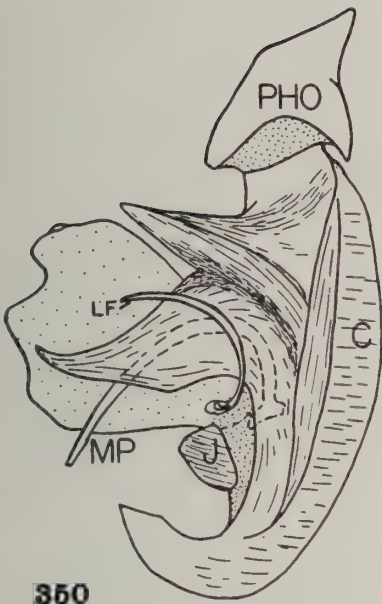


PLATE 27

*Tylomyia pedunculata* (Hall)

FIG. 362. Phallus, lateral view.

FIG. 363. Phallus, antero-ventral view.

FIG. 364. Lateral filaments, median process and juxta, ventral view.

FIG. 365. Fifth sternite.

*Fletcherimyia fletcheri* (Aldrich)

FIG. 366. Phallus, anterior view.

FIG. 367. Phallus, lateral view.

FIG. 368. Stemmatis and juxta, lateral view.

FIG. 369. Fifth sternite.

*Fletcherimyia jonesi* (Aldrich)

FIG. 370. Stemmatis, antero-dorsal view.

FIG. 371. Fifth sternite.

FIG. 372. Phallus, lateral view.

*Fletcherimyia rileyi* (Aldrich)

FIG. 373. Fifth sternite.

FIG. 374. Phallus, lateral view.

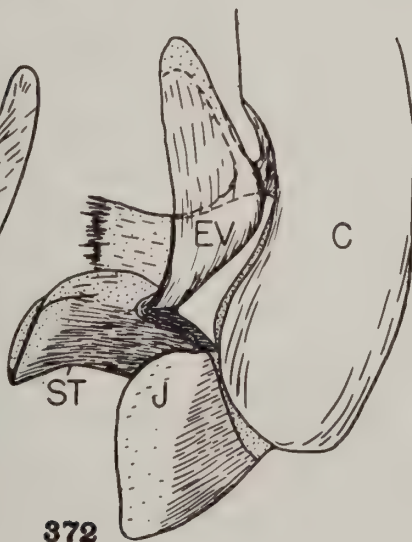
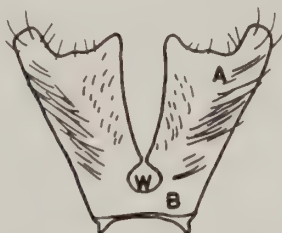
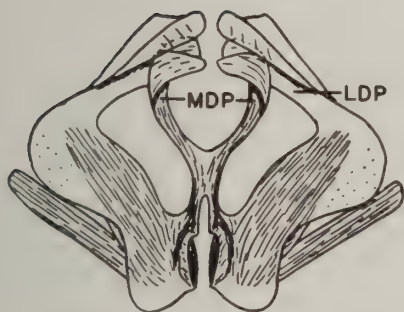
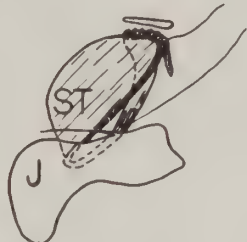
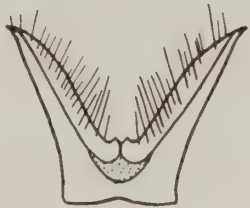
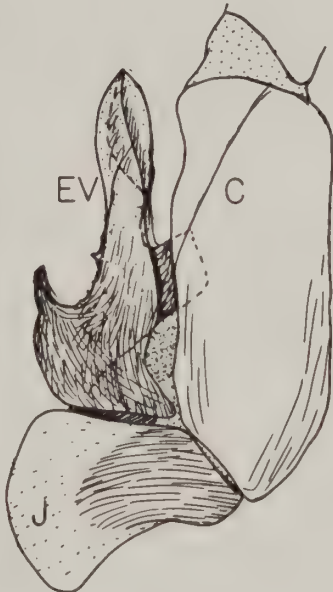
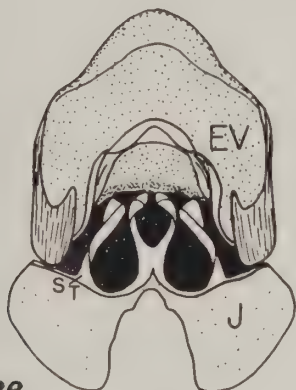
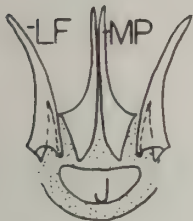
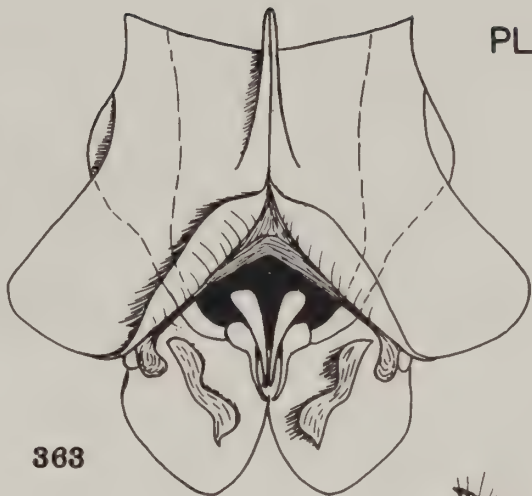
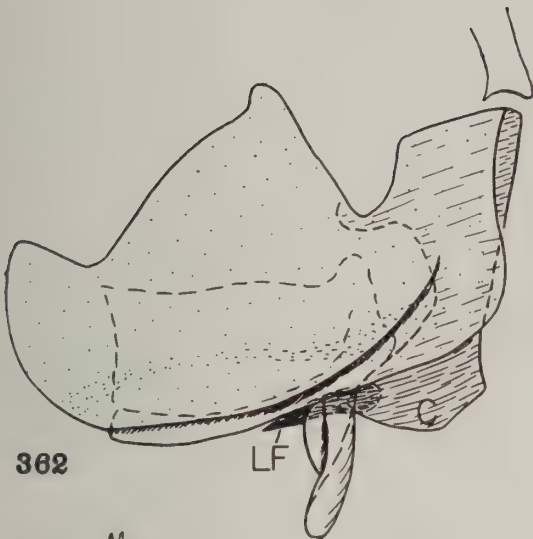




PLATE 28

*Fletcherimyia celarata* (Aldrich)

FIG. 375. Phallus, lateral view.

FIG. 376. Stemmatis, antero-dorsal view.

*Servaisia (Protodexia) opifera* (Coquillett)

FIG. 377. Phallus, lateral view.

FIG. 378. Phallus, antero-dorsal view.

FIG. 379. Fifth sternite.

*Servaisia (Protodexia) hunteri* (Hough)

FIG. 380. Phallus, lateral view.

FIG. 381. Fifth sternite.

FIG. 382. Tip of phallus, antero-ventral view.

*Servaisia (Servaisia) coloradensis* (Aldrich)

FIG. 383. Phallus, lateral view.

FIG. 384. Phallus, anterior view.

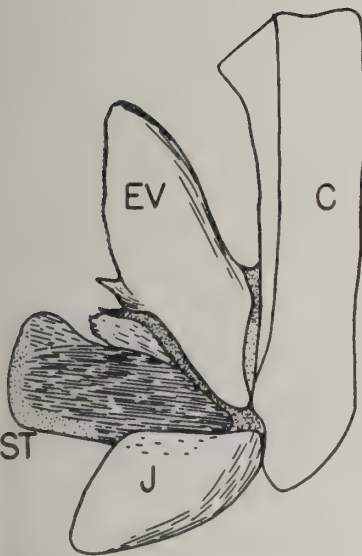
*Servaisia (Servaisia) erythrura* (Meigen)

FIG. 385. Tip of phallus, antero-dorsal view.

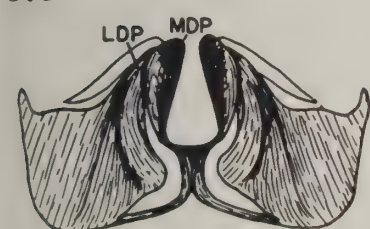
FIG. 386. Phallus, lateral view.

FIG. 387. Fifth sternite, dotted part missing in specimen.

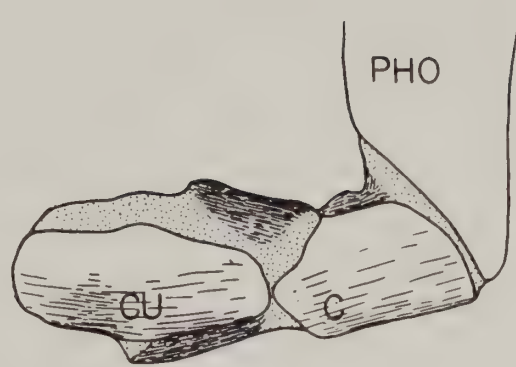
PLATE 28



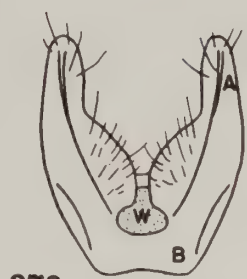
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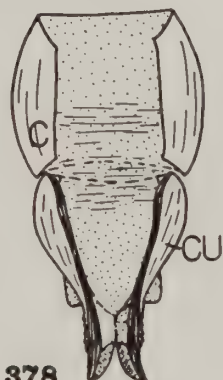
376



377



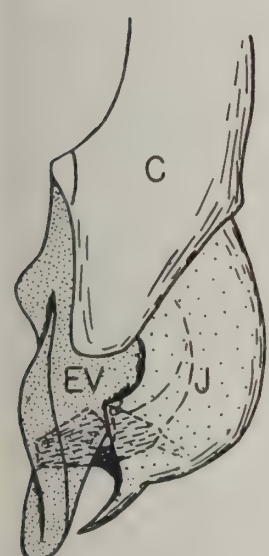
379



378



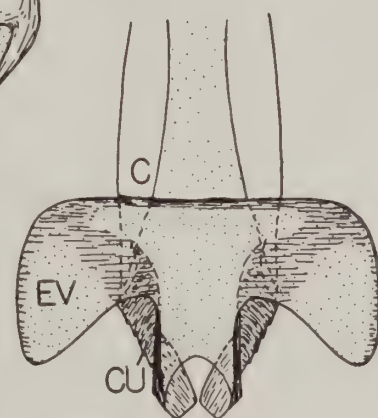
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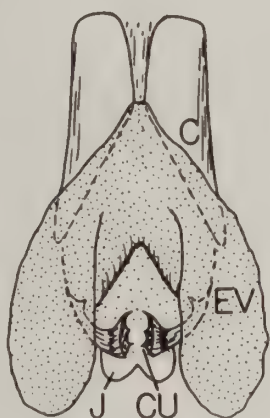
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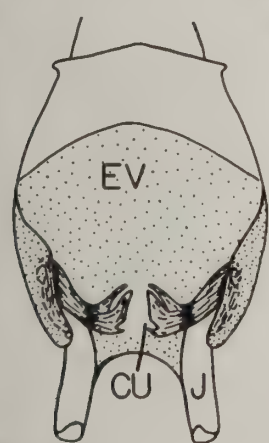
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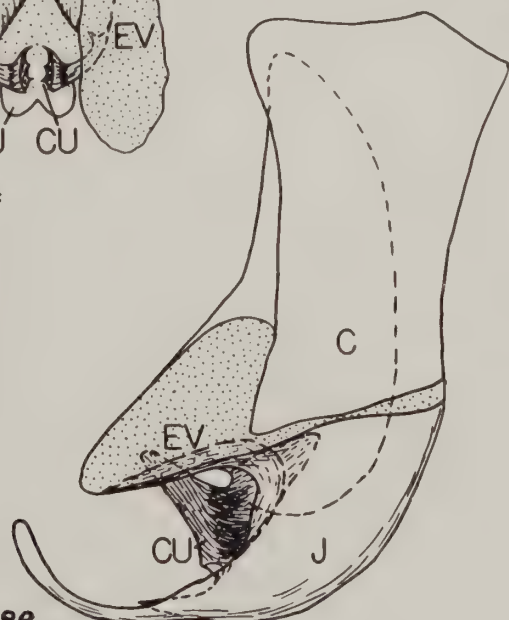
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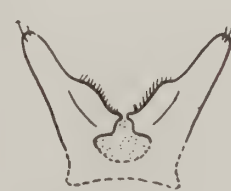
384



385



386



387

PLATE 29

*Servaisia (Sarpedia) setigera* (Aldrich)

FIG. 388. Fifth sternite.

FIG. 389. Phallus, lateral view.

FIG. 390. Phallus, anterior view.

*Servaisia (Servaisia) uncata* (Van der Wulp)

FIG. 391. Fifth sternite.

FIG. 392. Phallus, anterior view.

FIG. 393. Phallus, lateral view.

*Servaisia (Servaisia) falciformis* (Aldrich)

FIG. 394. Fifth sternite.

FIG. 395. Phallus, lateral view.

FIG. 396. Phallus, anterior view.

*Servaisia (Acridophaga) aculeata* (Aldrich)

FIG. 397. Phallus, lateral view.

FIG. 398. Phallus, anterior view.

*Servaisia (Acridophaga) reversa* (Aldrich)

FIG. 399. Phallus, lateral view.

FIG. 400. Fifth sternite.



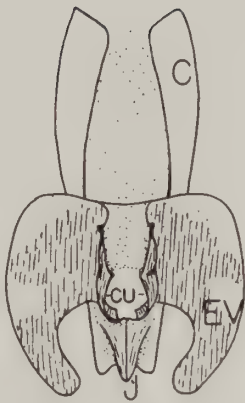
PLATE 29



388



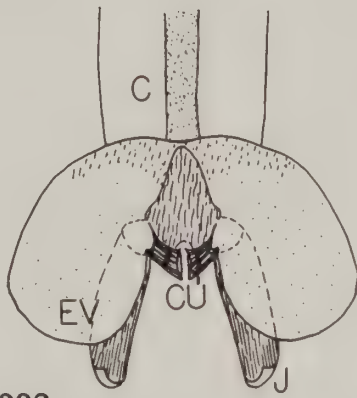
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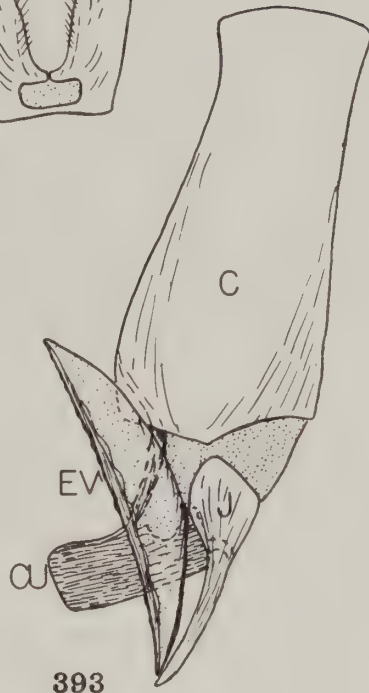
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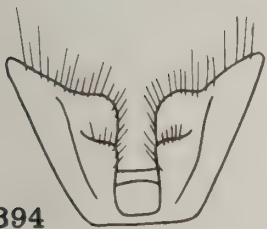
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392



393



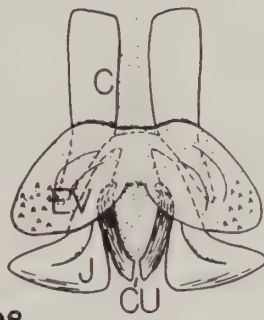
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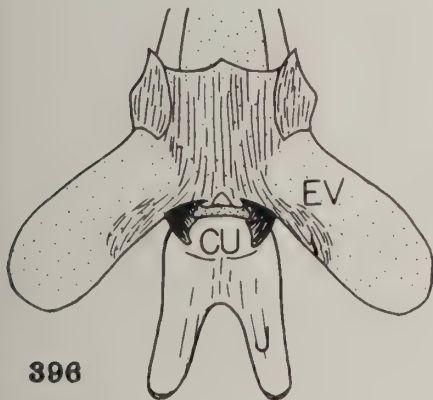
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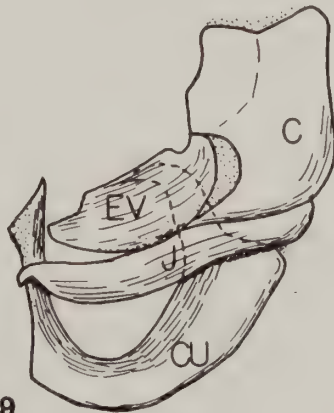
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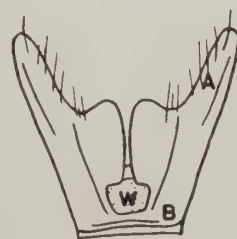
398



396



399



400

PLATE 30

*Servaisia (Acridophaga) angustifrons* (Aldrich)

- FIG. 401. Phallus, lateral view.  
FIG. 402. Phallus, anterior view.  
FIG. 403. Phallus, caudal view.  
FIG. 404. Fifth sternite.

*Servaisia (Acridophaga) caridei* (Brèthes)

- FIG. 405. Fifth sternite.  
FIG. 406. Phallus, anterior view.  
FIG. 407. Phallus, lateral view.

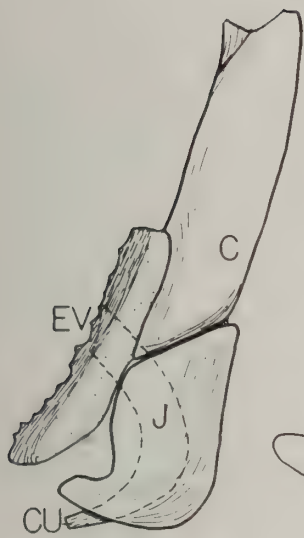
*Kurtomyia postilla* (Reinhard)

- FIG. 408. Fifth sternite.  
FIG. 409. Phallus, anterior view.  
FIG. 410. Phallus, lateral view.

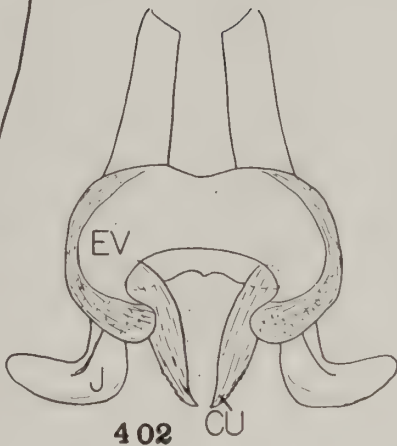
*Servaisia (Speciosia) speciosa* (Lopes)

- FIG. 411. Fifth sternite.  
FIG. 412. Phallus, lateral view.

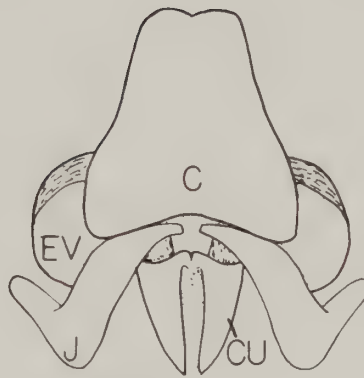
PLATE 30



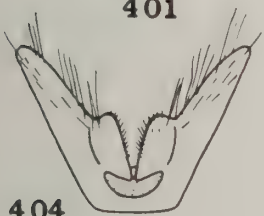
401



402



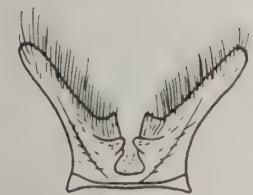
403



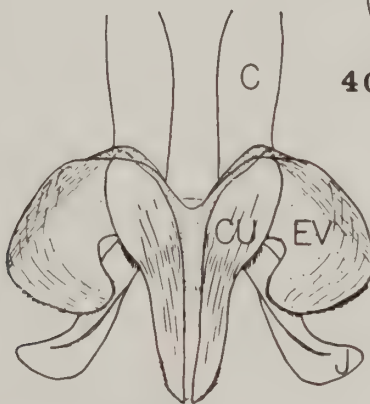
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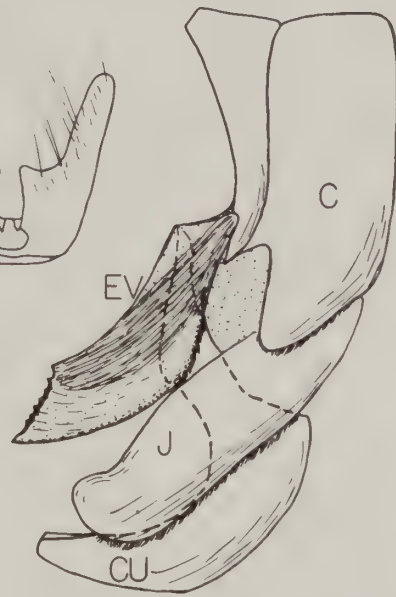
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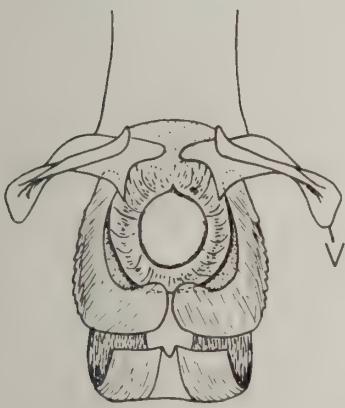
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407



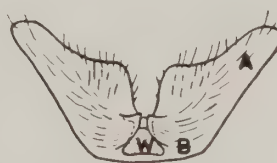
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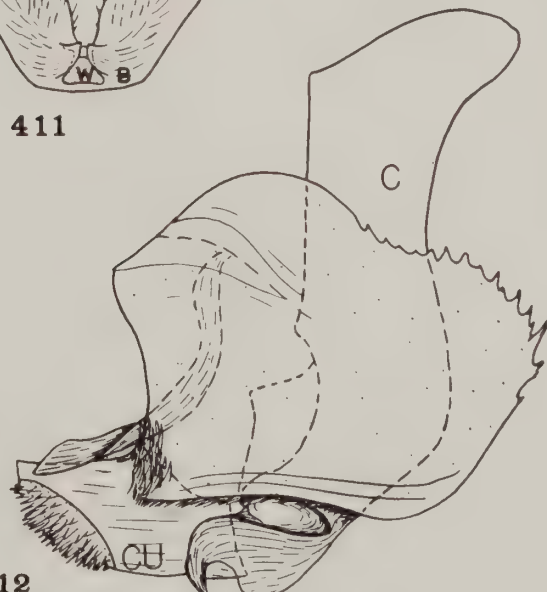
409



410



411



412



PLATE 31

*Acandotheca (Stenolaucotheca) spatulata* (Aldrich)

FIG. 413. Fifth sternite.

FIG. 414. Phallus, lateral view.

FIG. 415. Phallus, anterior view.

*Acandotheca (Tephromyiella) atlanis* (Aldrich)

FIG. 416. Phallus, lateral view.

FIG. 417. Fifth sternite.

FIG. 418. Tip of phallus, antero-ventral view.

*Acandotheca (Mecynocorpus) salva* (Aldrich)

FIG. 419. Fifth sternite.

FIG. 420. Phallus, lateral view.

FIG. 421. Limen, dorsal view.

*Acandotheca (Lepyria) melampyga* (Aldrich)

FIG. 422. Fifth sternite.

FIG. 423. Phallus, lateral view.

FIG. 424. Phallus, anterior view.

*Acandotheca (Acandotheca) alcedo* (Aldrich)

FIG. 425. Tip of phallus, anterior view.

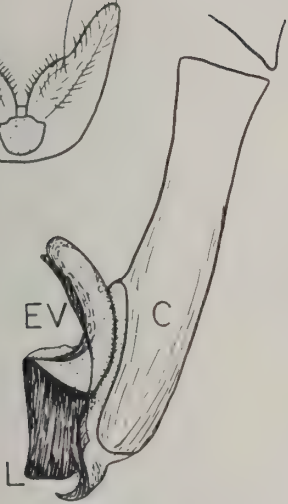
FIG. 426. Fifth sternite.

FIG. 427. Phallus, lateral view.

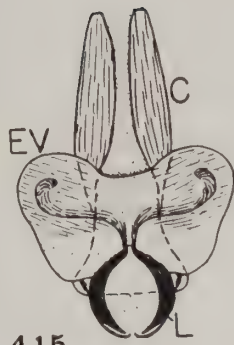
PLATE 31



413



414



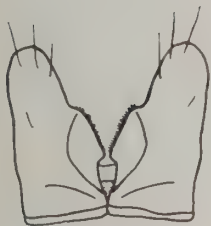
415



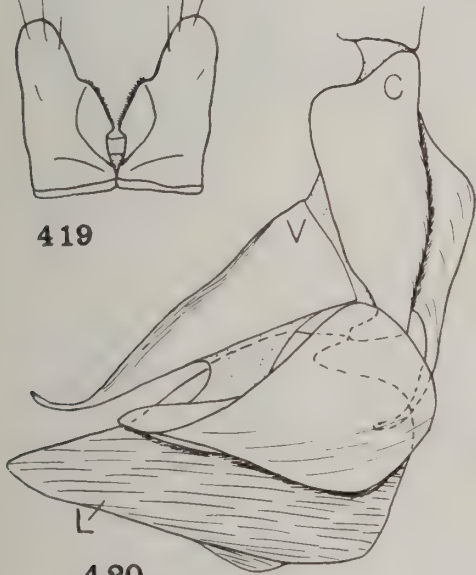
416



417



419



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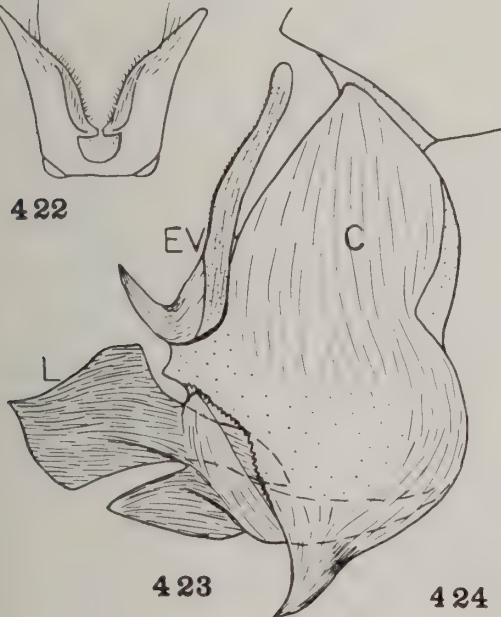
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PLATE 32

*Acandotheca (Acandotheca) hamata* (Aldrich)

FIG. 428. Phallus, lateral view.

FIG. 429. Phallus, antero-dorsal view.

FIG. 430. Fifth sternite.

*Acandotheca (Acandotheca) rudis* (Aldrich)

FIG. 431. Fifth sternite.

FIG. 432. Phallus, lateral view.

FIG. 433. Phallus, ventro-caudal view.

*Acandotheca (Acandotheca) masculina* (Aldrich)

FIG. 434. Phallus, anterior view.

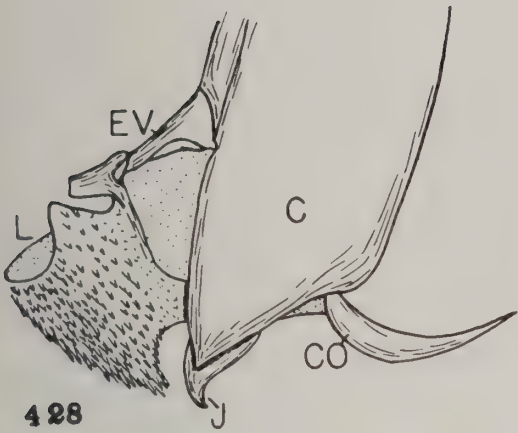
FIG. 435. Phallus, lateral view.

*Acandotheca (Acandotheca) prohibita* (Aldrich)

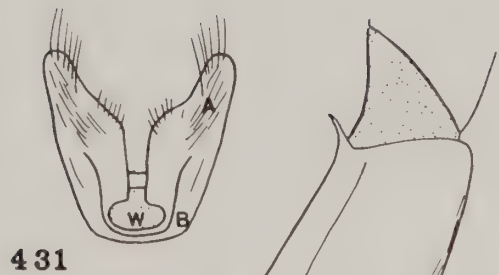
FIG. 436. Phallus, lateral view.



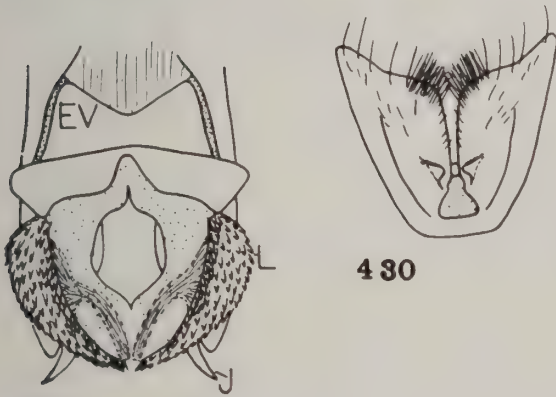
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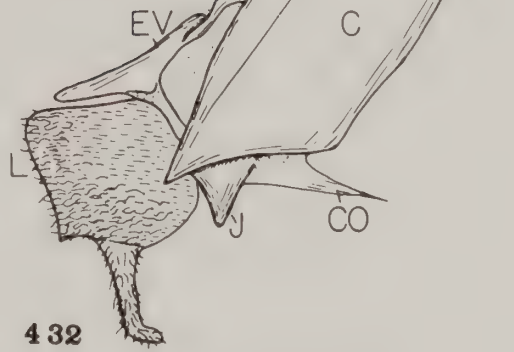
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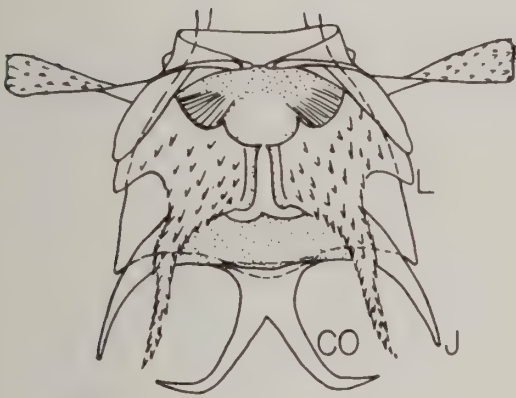
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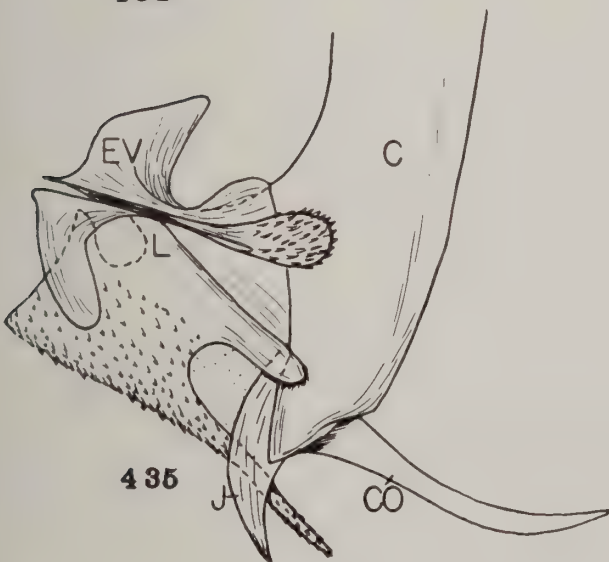
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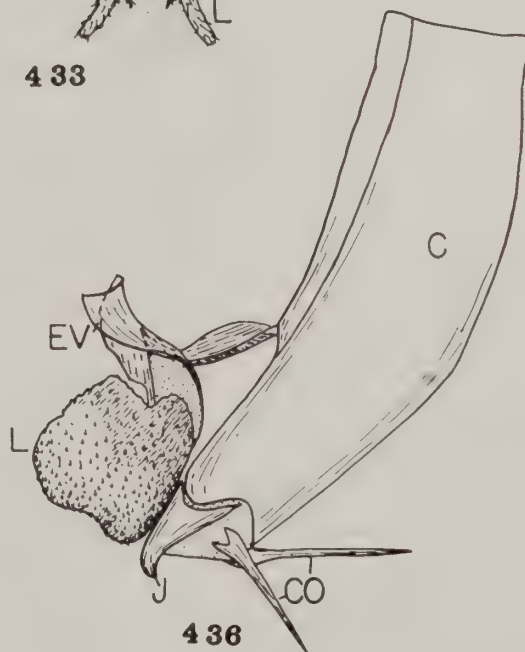
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PLATE 33

*Acandotheca (Acandotheca) complosa* (Reinhard)

FIG. 437. Phallus, lateral view.

FIG. 438. Phallus, anterior view.

FIG. 439. Fifth sternite.

*Acandotheca (Acandotheca) eleodis* (Aldrich)

FIG. 440. Fifth sternite.

FIG. 441. Phallus, lateral view.

*Xenoppia hypopygialis* Townsend

FIG. 442. Phallus, anterior view—lateral plates spread apart.

FIG. 443. Phallus, lateral view.

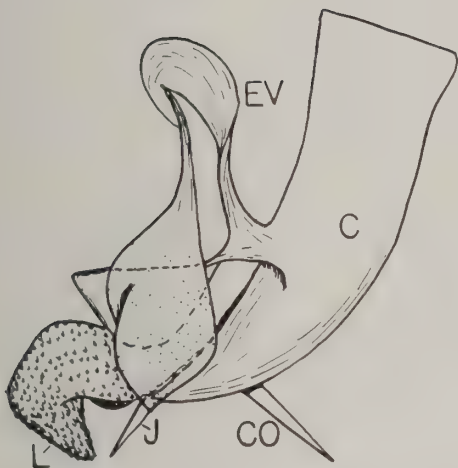
FIG. 444. Tip of phallus, lateral view—lateral plates removed.

FIG. 445. Fifth sternite.

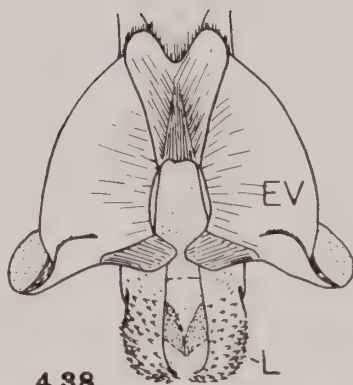
*Neophyto setosa* Coquillet

FIG. 446. Phallus, lateral view.

FIG. 447. Fifth sternite.



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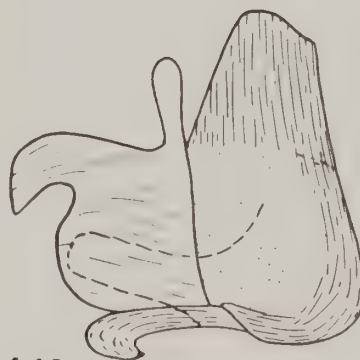
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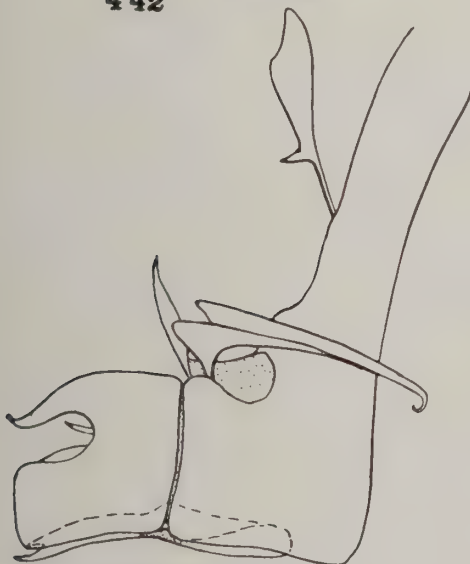
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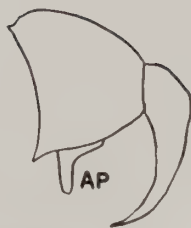
PLATE 34

- FIG. 448. *Wohlfahrtia meigeni* (Schiner), abdomen, dorsal view. (After Aldrich 1916.)
- FIG. 449. *Sarcofahrtia ravinia* Parker, anal plate and anal forceps, lateral view. (After Aldrich 1916.)
- FIG. 450. *Boettcheria similis* Lopes, anal plate. (After Lopes 1946a.)
- FIG. 451. *Imparia impar* (Aldrich), tip of anal forceps, lateral view. (After Aldrich 1916.)
- FIG. 452. *Kellymyia kellyi* (Aldrich), tip of anal forceps, lateral view. (After Aldrich 1916.)
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- FIG. 456. *Acandotheca* (*Acandotheca*) *eleodis* (Aldrich), anal forceps, lateral view. (After Aldrich 1916.)
- FIG. 457. *Acandotheca* (*Mecynocorpus*) *salva* (Aldrich), tip of anal forceps, lateral view. (After Aldrich 1916.)
- FIG. 458. *Servaisia* (*Speciosia*) *speciosa* (Lopes), anal forceps, lateral view. (After Lopes 1946a.)
- FIG. 459. *Wohlfahrtiopsis johnsoni* (Aldrich), tip of anal forceps, lateral view. (After Aldrich 1916.)
- FIG. 460. *Metoposarcophaga* (*Zygastropyga*) *sulculata* (Aldrich), apical section of abdomen, lateral view. (After Aldrich 1916.)

PLATE 34



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## X. Index

The page entries in **boldface** refer to the main treatment of the subgenera, genera, and higher categories. Names that are synonyms or of changed generic placement are in *italics*. Those names which are in keys or in figure headings are not listed.

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